

# ROADS and STREETS

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## FEATURES OF CLEVELAND'S MAIN AVENUE BRIDGE

*Welding, Longest Span Girders,  
Column Spread Footings, Expansion on Curves*

*John O. McWilliams  
County Engineer*

*By  
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Cuyahoga County, Ohio*

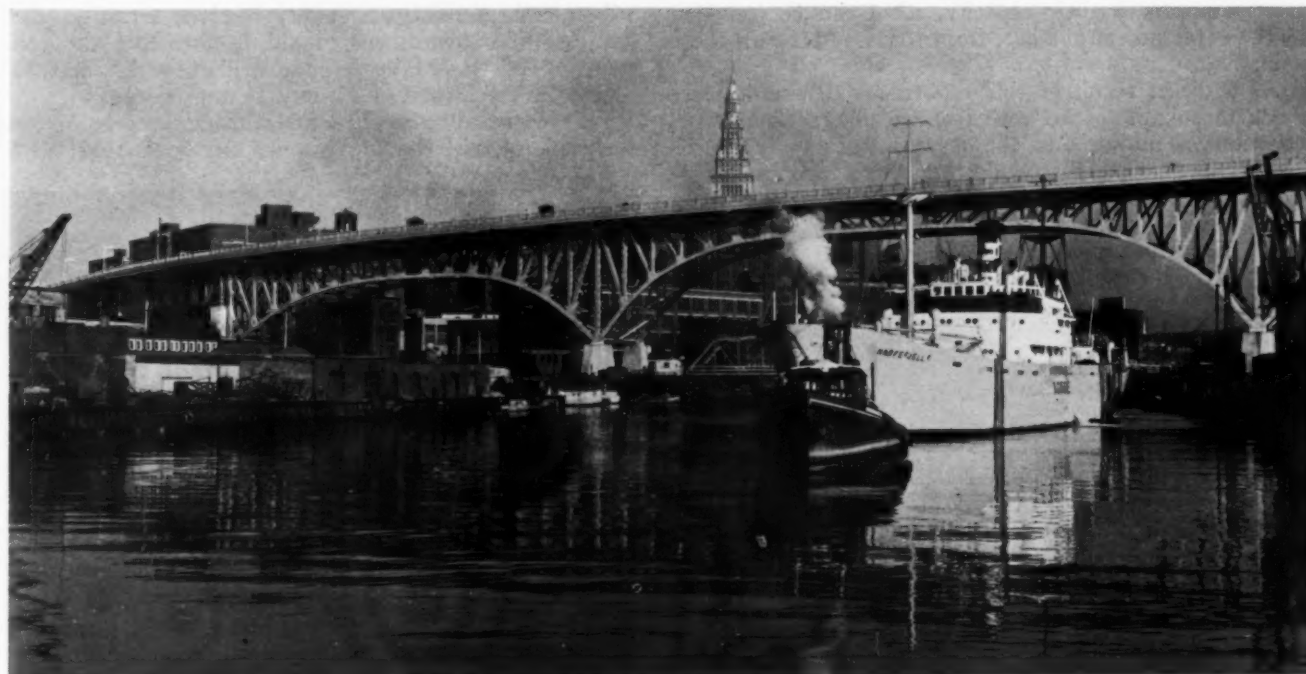
*Fred L. Plummer  
Chief Design Engineer*

ATTENTION was called to the need of a high level bridge in the vicinity of Main Avenue, Cleveland, in order to relieve congestion on the Detroit-Superior bridge, in 1928 when the Bureau of Public Roads and the Board of County Commissioners of Cuyahoga County published a report of a plan of Highway Improvement in the Regional Area of Cleveland. The bridge would also form a proper connection between Bulkley Boulevard west of the Cuyahoga River and a proposed Lakefront Road east of the river.

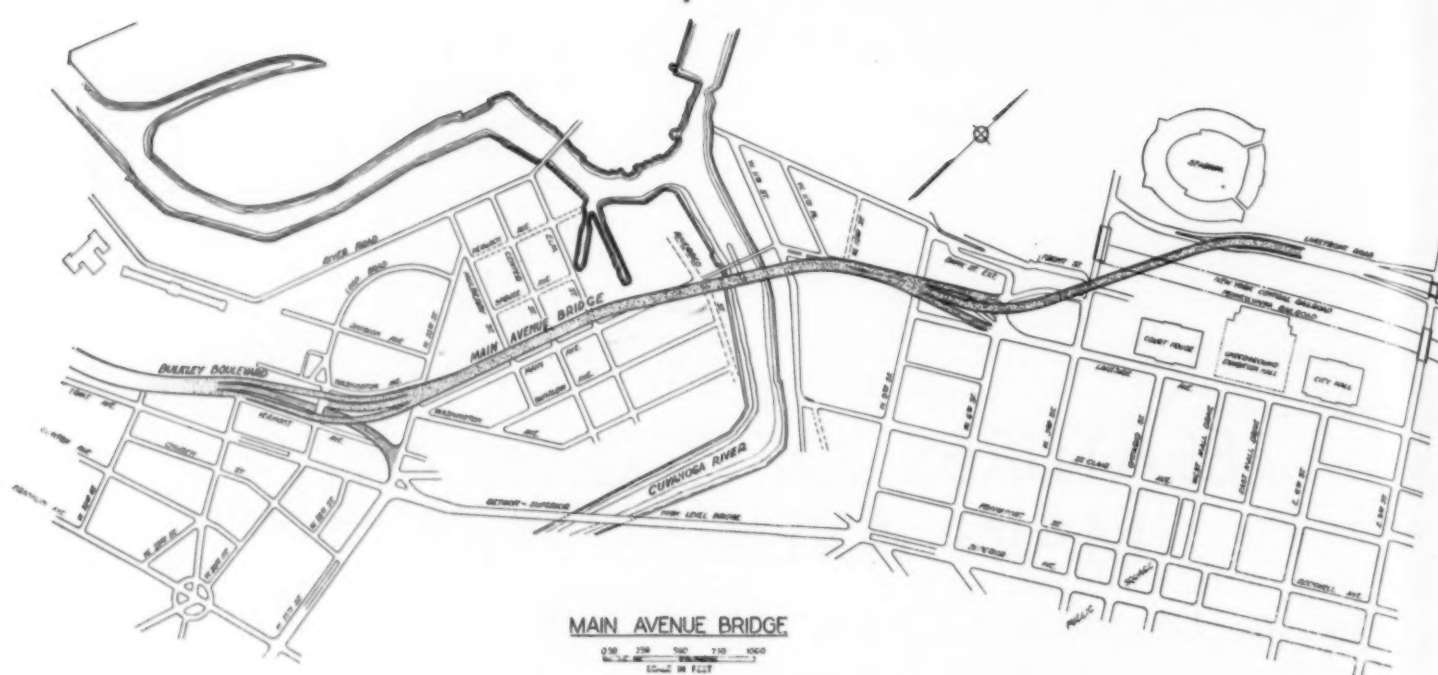
### Historical

This report contains the following statements regarding the then proposed Main Avenue bridge:

"An improvement in the city of Cleveland which will facilitate traffic movement between the western section of the county and the central business section of Cleveland is the proposed new high-level crossing of the Cuyahoga River in the vicinity of the present Main Street bridge. Traffic between the central business sec-



*Main Avenue Bridge River Span, Cleveland, Ohio.*



General Plan of Main Avenue Bridge, Cleveland, Ohio

tion of Cleveland and the western centers of traffic crosses either the present Superior high level bridge, which carries 56,000 vehicles per day, or the present Main Street low level bridge, which carries a daily traffic of 7,000 vehicles. The proposed bridge, if it had been built in 1927, would have carried a minimum of 18,000 vehicles per day. Connections of this bridge with the proposed lake front development east of the Cuyahoga River will also permit traffic destined to points east of the Public Square to by-pass this congestion-center. Between the eastern terminus of the proposed Rocky River crossing and the western approach to the proposed Cuyahoga River crossing, present traffic is well served by Lake Avenue, Clifton Boulevard, Edgewater Drive, and Bulkley Boulevard. When these arteries approach their capacity, relief can be provided by the development of a lake front roadway between these points."

As a direct result of this report, arrangements were made to submit to the voters of Cuyahoga County the question of authorizing the issuance of bonds in the amount of \$6,000,000 to build the bridge and a favorable vote thereon obtained in November, 1930.

Shortly after the authorization of the issuance of bonds, plans for the Main Avenue bridge were started. The plans had reached the stage of development, which in-

cluded the determination of line, grade, type of structure, location and approach treatment, together with a considerable number of detail drawings, when the economic situation of Cuyahoga County became such that the responsible officials of the county determined to abandon the project, at least temporarily.

By October, 1936, the economic situation in Cuyahoga County had cleared up to such an extent that the Board of County Commissioners decided to file an application for a PWA grant with the Federal Government, for the purpose of building the Main Avenue bridge. The figures and supporting data used in filing this application for a grant were based entirely on the plans which had been prepared before the project was temporarily abandoned.

In October, 1937, the county received an offer from the Federal Government to aid in financing the construction of the Main Avenue bridge, which was accepted by the Board of County Commissioners.

In the meantime a Federal housing project on the west side of the river and several city sponsored WPA



Starting Excavation of Pier 8 on West River Bank.



Driving Fluted Piling.

projects on the east side of the River had either been completed or were under construction. Some of these projects very materially affected the approaches to the Main Avenue bridge as originally planned.

### Development of Approach Plans

In order to meet these changed conditions and in order to provide as nearly as possible for a free and uninterrupted flow of traffic between the main structure and existing streets at either end, the County Bridge Department under the direction of John O. McWilliams, County Engineer, prepared a number of studies for both of the approaches.

From these studies the two plans shown herewith as the Main Avenue Bridge West Approach and Main Avenue Bridge East Approach were adopted.

From a study of these plans it will be seen that both the west approach, west of West 25th Street and the east approach, east of West 9th Street, in general consist of a series of ramps leading from the main structure to the various existing streets.

**West Approach.**—The federal housing project previously referred to, is located just north of the west approach and is accessible only from West 25th Street and West 28th Street. It was therefore necessary to plan the west approach without altering the existing grades of these two streets.

Bulkley Boulevard which is a four lane highway to the west, crossed West 28th Street at grade with a traffic light at the intersection of these two streets. This boulevard, from a traffic count made in 1934, carried a total of 28,000 vehicles daily to and from the Detroit-Superior high level bridge.

A four lane roadway marked "Subway Ramp" on the plan was provided for this traffic. This ramp passes under West 28th Street and meets the present grade of West 25th Street at the easterly end and the present

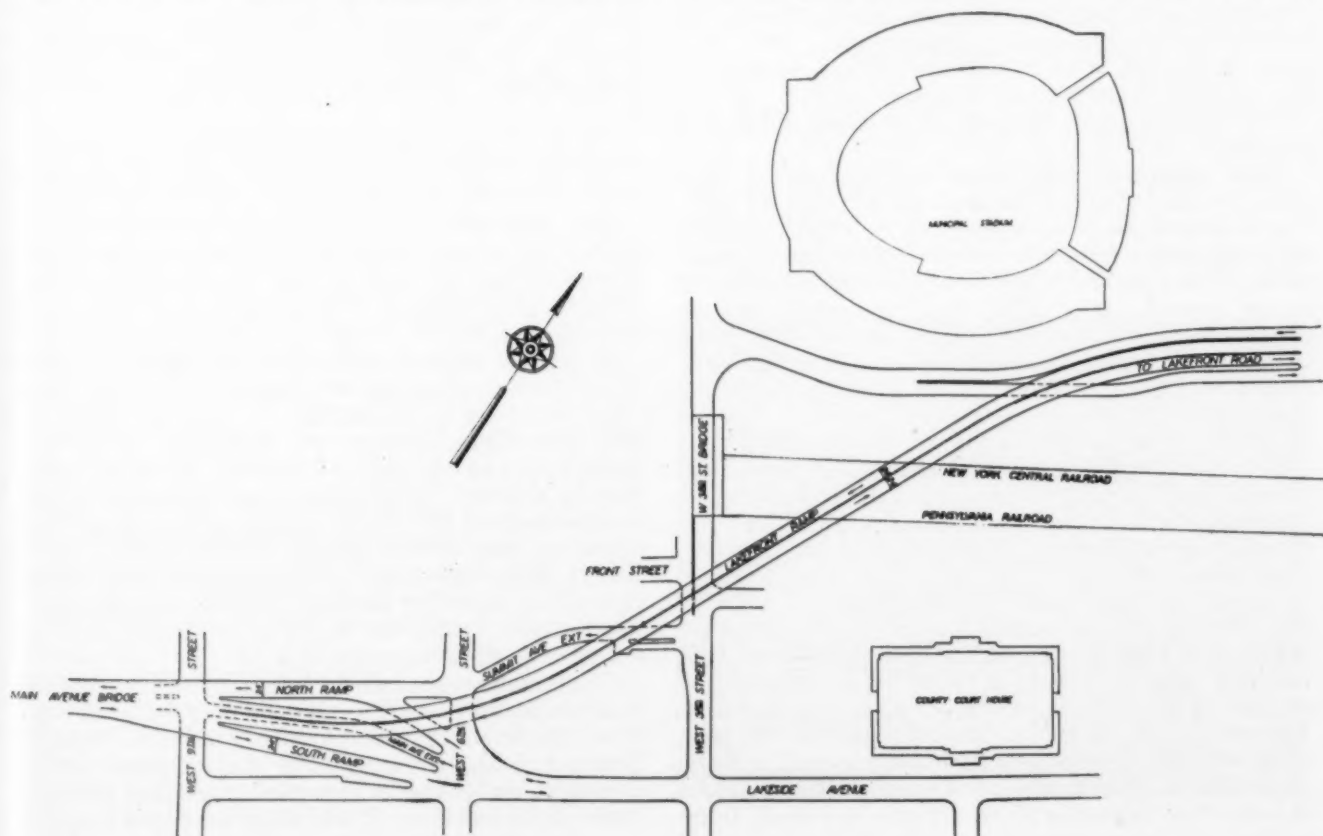


*Fluted Tapered Steel Pile Shell Driven 50 to 60 Feet Below Bottom of Footing and Filled With Concrete.*

grade of Bulkley Boulevard just west of West 29th Street. This ramp consists of two 12 ft. traffic lanes in each direction separated by a raised center strip 2 ft. wide and a narrow escape walk on each side.

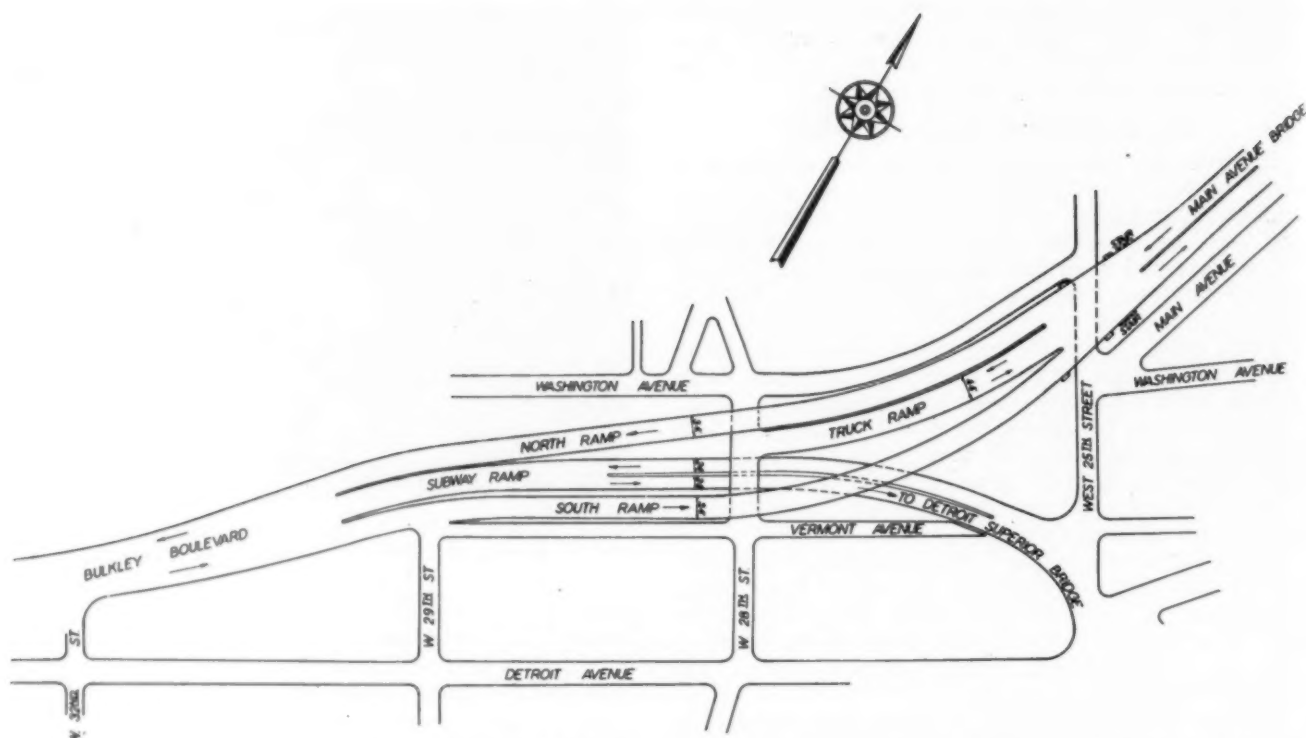
Two ramps marked "North Ramp" and "South Ramp" on the plan were provided for the west and east bound traffic between Bulkley Boulevard and the Main Avenue bridge structure which passes over West 25th Street. Both these ramps pass over West 28th Street and each ramp consists of a 34 ft. roadway and one escape walk 18 in. wide. Each roadway is divided into three traffic lanes with the two outside lanes each 12 ft. wide and the center lane 10 ft. wide.

Another ramp between the north and south ramp



*Main Avenue Bridge East Approach, Cleveland, Ohio*





West Approach Layout for the Main Avenue Bridge, Cleveland, Ohio. Note Crossings at Three Elevations Over West 28th St.

marked "Truck Ramp" leading from the main structure to the grade of West 28th Street was provided to furnish access to the bridge for north and south bound traffic on West 28th Street. At the present time truck traffic is not permitted on Bulkley Boulevard to the west. All truck traffic on the bridge will therefore have to leave or enter by way of this ramp, hence the name "Truck Ramp," until such time as Bulkley Boulevard can be rebuilt to accommodate truck traffic. This ramp has a total width of 44 ft. between curbs, providing for two lanes of traffic in each direction.

The maximum rate of grade on all these ramps is 4 per cent.

**West Approach Structures.**—In general the west approach ramps are constructed on fill between reinforced concrete retaining walls or on reinforced concrete slab and girder frames enclosed with concrete curtain walls. However, there are several small structures of special interest. West 28th Street is carried over the subway on a two span reinforced concrete rigid frame of the barrel type. The spans are each 27.5 ft. The thickness of the slab at the crown is 16 in. and at the haunch 24 in.

The north and south ramps are carried over West 28th Street on similar three span, welded steel rigid frames. These two small bridges are the first all welded bridges to be built in the Cleveland area. The three spans are approximately 24, 71 and 27 ft., respectively. Each of the ramps, which are 40 ft. 6 in. wide, is carried on two frames spaced about 26 ft. apart. The frames are constructed from standard rolled shapes and were designed to require a minimum of field welding. The resulting structures have a pleasing appearance and were more economical than similar riveted construction. The south ramp passes over the subway at a very large skew on riveted steel frames having a total span of about 226 ft. The north frame consists of three spans of which the longest is 95 ft. whereas the south frame consists of four spans varying in length from 40 to 84 ft. Because of the irregular spacing of columns made

necessary by the skew construction over the subway, it was difficult to design suitable bracing to care for centrifugal, wind, and temperature forces.

The main structure is carried over West 25th Street on three large riveted steel girders resting on concrete piers. The structure is widened at this section to provide the 10 traffic lanes of the north, south, and truck ramps. In consequence the floor framing is quite complicated. The floor rests on stringers carried by floor beams attached directly to steel columns or to the three girders.

All of the west approach construction is supported on spread footings resting on a sand soil of good quality over a very deep deposit of soft to medium hard clay.

**East Approach.**—One of the city sponsored WPA projects previously referred to as affecting the Main Avenue bridge approaches was the development of a Lakefront Road from Gordon Park or East 72nd Street westerly to East 9th Street.

Under the original design the east approach to the bridge came to grade and terminated at West 6th Street and offered no provision for a connection with this Lakefront Road, since at the time these plans were made, this road was not in existence. In order to provide for a direct connection between the bridge and this Lakefront Road the county engineer developed and presented the plan shown herewith marked "Main Avenue Bridge East Approach." This approach also consists of a series of ramps leading from the main structure, which passes over West 9th Street to the various existing or new streets.

The center ramp marked "Lakefront Ramp" joins the structure at West 9th Street, passes over the north ramp, West 6th Street, Summit Avenue Extension, West 3rd Street, and also over the New York Central and the Pennsylvania Railroad Companies' tracks and meets the grade of the Lakefront Road, which the city is extending westerly under East 9th Street, at a point about 160 ft. easterly of the Mall axis. Thus providing for a direct





*Pouring Concrete on Pier 8 Footing Mat. Men Are Working in Space Between Top and Bottom Reinforcing Steel. Mat is 38 Ft. by 93 Ft. by 5 Ft. 6 In.*

connection between the Lakefront Road and the bridge with all street intersections eliminated.

From West 9th Street to just easterly of West 3rd Street the construction consists of eight steel rigid frame structures having a total length of 1,206 ft. The deck structure, 55 ft. wide, rests on longitudinal stringers and cross floor beams attached to two lines of frames spaced 39 ft. apart. Almost the entire length of structure is built on a horizontal curve having a centerline radius of 1,000 ft. Because of this curvature and of the large number of skew crossings, the two lines of frames are largely dissimilar, thereby increasing the difficulty of providing for centrifugal and other lateral forces.

The individual spans for the several frames vary from a minimum of 13 ft. to a maximum of 122 ft. The lower flange of the frames is curved throughout its length to produce a uniform and pleasing outline for the structure. All of the frames are supported on short concrete piers resting on spread footings.

From West 3rd Street the Lakefront ramp is carried on a down grade of 4.15 per cent on three, four-span, continuous steel girders crossing the tracks of the Pennsylvania and New York Central Railroads with a skew of approximately 57 degrees. The total length of the girders is about 858 ft., the maximum span for each line being the 270.8 ft. span across the railroad tracks. Owing to the horizontal curve near the end of this section, there is an angle in each girder at Pier 40 which is the anchor pier. The girders across the railroad tracks are the longest span girders to be built in either North or South America. These girders are 12 ft. deep throughout the central portion of the span, increasing in depth from a point 60 ft. from either end of the span to a maximum depth of 15 ft. 8 in. at the piers. The bridge deck is carried on cross joists resting directly on the three girders, the floor and joists acting as the upper lateral bracing except at sections adjacent to the piers. Lower lateral bracing is provided in the plane of the lower flanges except near the skew piers adjacent to the railroad tracks where it is kept above the flanges to simplify connections at the piers. Cross frames of the Vierendeel type are provided at intervals of about 18 ft. Special truss bracing is provided at the various piers.

Because of space restrictions imposed by the railroads, it was necessary to design piers having very small lateral dimensions. In consequence steel shell piers filled with concrete were used. These piers are anchored into a

7 ft. concrete mat by a steel grillage which also ties the pier to sheet piling which surrounds the mat. The 7 ft. anchorage mat is carried on a 3 ft. working mat poured on the underlying clay soil and also tied to the sheet piling which is driven some 20 ft. below the bottom of the mat into the underlying clay soil. The tops of the steel shafts are tied together with a steel box girder strut.

This ramp consists of two 12 ft. traffic lanes in each direction separated by a raised center strip 18 in. wide and two escape walks each 18 in. wide with a total overall width of 55 ft.

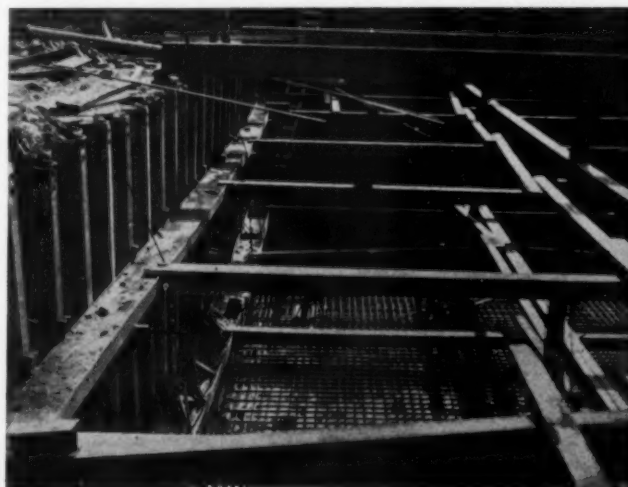
Two ramps marked "North Ramp" and "South Ramp" provide for west and east bound traffic between Lakeside Avenue and the main structure. Both of these ramps meet the present grade of West 6th Street at Lakeside Avenue and each ramp consists of a three-lane roadway 34 ft. wide with a 5 ft. sidewalk on the outside of each ramp. The ramp pavements are built on fill placed between reinforced concrete retaining walls.

The south ramp encroaches upon or occupies the northerly half of Lakeside Avenue at West 6th Street so that Lakeside Avenue between West 9th and West 6th Street will be a one-way street for east bound traffic only. For the west bound traffic a twenty-four foot roadway marked "Main Avenue Extension" was provided. This roadway meets the existing grades of West 6th Street and West 9th Street and passes under the Lakefront ramp between the columns supporting the ramp. This roadway also provides access to the low level Main Avenue which lies directly under the main bridge structure from West 9th Street westerly. West 3rd Street is one of the two main thoroughfares leading to Cleveland's Municipal Stadium located on the lake front. In order to furnish access from this thoroughfare to the bridge a new 30 ft. roadway marked "Summit Avenue Extension" was provided. The maximum rate of grade on the north and south ramps is 4 per cent.

### Main Bridge Structure

After having decided on the location and the type of approaches which would provide as nearly as possible for a free and uninterrupted flow of traffic between a main structure and existing streets at either end, the plans for a main bridge structure connecting these two approaches were developed.

The main bridge structure crosses the Cuyahoga River and valley commonly referred to as the "flats." Due to



*Cofferdam and Bracing on Pier 9 on East River Bank. Bottom Is 24 Ft. Below Ground Line.*

existing streets in the flats, a low level swing bridge across the river which had to be maintained, and also due to economical right-of-way between the approaches it was necessary to select an alignment with two curves in the main structure as shown on the plans.

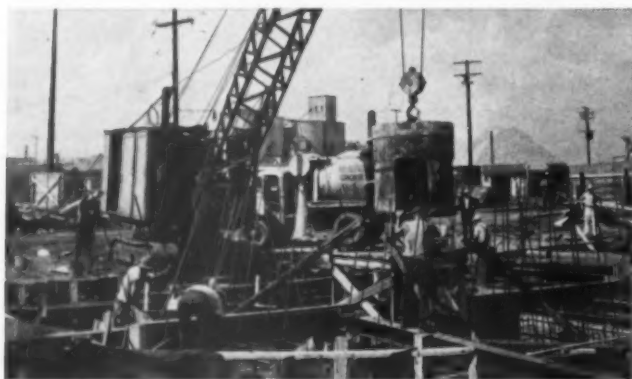
Between Pier O and West 25th Street, the beginning of the west approach, there is a short section of continuous beam construction of concrete. Between Pier 10 and West 9th Street, the beginning of the east approach, the entire construction is of steel which includes the simple trusses of Span 11 across the tracks of the C.C.C. and St. L. R. R., and the two deck steel column and girder construction providing a private access roadway to the fifth floor level of the National Terminal Corporation buildings.

The two deck construction is carried on three lines of columns spaced 29 ft. 3 in. center to center. In each line the columns are spaced about 40 ft. apart. The floor beams and stringers are designed for continuity. The design of the columns required a careful study to provide the necessary stiffness to resist lateral forces due to wind and centrifugal action, and longitudinal traction forces and yet not result in excessive stresses due to temperature distortions. Lateral and longitudinal bracing are shown in the accompanying photographs. It was necessary to hinge at the base certain of the shorter columns located near West 9th Street which the structure crosses with the minimum allowable clearance.

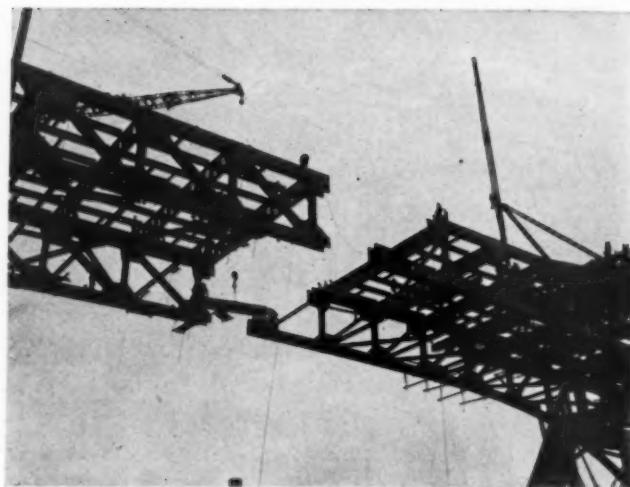
All of the steel columns are carried on short reinforced concrete piers resting on spread footings. The footings for Columns 201, 202, 301, 302 rest on a heavy continuous foundation mat which had supported the columns of the five story warehouse building which was removed to provide space for construction of the bridge. The mat had been designed to carry four additional stories of construction similar to the five which it had supported for several years without appreciable settlement. The adjacent footings for Columns 11N, 11S, 101, 102 rest on wet sand soils. In order to prevent possible flow of this material and to reduce settlement to a minimum, these footings were surrounded by and attached to sheet piling driven 15 to 20 ft. below their bottoms.

The continuous cantilever truss construction, between Pier O and Pier 10, usually referred to as the steel superstructure, consists of 10 spans varying in length from 200 to 400 ft. The total length of the 10 spans from center to center of end bearings is 2,520 ft.

The span over the Cuyahoga River was set at 400 ft. in order: (1) to meet War Department requirements as to channel width and vertical clearance; (2) that the adjacent piers might be built on stable ground; (3) that the form of the truss might be made to conform



*Pouring Concrete in Hollow Pier Shaft. Note Use of Truck Mixed Concrete.*



*Placing First Closing Member of Cantilever Erection of River Span. Erection Jacks Are Located at Points Where Pins Can Be Seen in Picture.*

with that adopted for the remainder of the structure. The remaining span lengths and pier locations were fixed so as to avoid interference with the many existing streets and railroad tracks, giving as much consideration as possible to the most economic span lengths.

Owing to the cost of adequate foundations neither reinforced concrete nor steel arch construction could compete for design. A series of truss anchor spans with cantilever arms and short intermediate suspended spans, were found to be most economical. This type of truss construction combines the advantages of continuous trusses with the possibilities of providing a pleasing outline for the structure and at the same time eliminates difficulties which might result from serious differential settlement of the various piers. The piers are placed on soft to medium hard clay soil layers 150 to 200 ft. thick. Simple span trusses were not considered because of the difficulty of combining good appearance with reasonable economy.

The lower chord of the trusses is curved, giving the structure the architectural appearance of a series of arches. In order to produce a more pleasing outline, the trusses were made somewhat deeper at the piers than necessary for maximum economy. The depth of the suspended span over the river was kept to a minimum in order to decrease the approach grade from the east and to minimize the "climb" for all traffic passing over the bridge.

The trusses were designed to carry the heaviest loads specified in the standard design specifications of the State of Ohio. Complete deflection and secondary stress investigations were made for the entire structure. Both upper and lower chord members are constructed of closed box sections with closely spaced manholes on the under sides for fabrication, inspection and maintenance. Verticals, diagonals, and bracing members are generally H-section members consisting of rolled wide flange beams with cover plates. Some of the more heavily stressed web members consist of box sections similar to the chords. The lower lateral bracing and the sway bracing are of the K-type. Except at sections where the roadway is built to fit a horizontal curve, the deck acts as the only upper lateral system. The use of this type of bracing and of box and H-section members eliminating all lacing bars, produced a clean cut, sturdy structure of very pleasing appearance.

The trusses rest on hollow reinforced concrete pier





*Cantilever Erection Was Used on River Span. For Other Spans, Steel Tower Falsework Was Employed.*

shafts extending from a few to as many as 30 ft. above grade. The shafts are tapered slightly, the largest varying from 12.2 ft. by 13.6 ft. at the top to 20 ft. by 20 ft. at the ground line. All of the pier shafts except Nos. 8 and 9, the two piers adjacent to the river, are supported on spread footings resting on closed end fluted steel shells driven from 50 to 60 ft. into the underlying clay soil and filled with concrete. The shafts of the two river piers rest on continuous footing mats 5 ft. 6 in. thick. The bottoms of these mats which are 38 ft. wide by 93 ft. long, are about 24 ft. below grade. The mats are surrounded by sheet piling driven 20 ft. below the bottom of the mats and left in place in order to make impossible the lateral flow of the underlying material in case the river is ever deepened by dredging or scour.

**Erection.**—The company which fabricated and erected the steel trusses chose to erect all of the spans with the exception of the river span, No. 9, on steel erection towers built under alternate truss panel points. After all spans except the river span had been completed, the trusses of this span were erected from each end by the cantilever method as illustrated in the accompanying pictures. Six hydraulic jacks were located at the points indicated in Figure 1 at the ends of the suspended span in order to provide the necessary closing adjustments.

All of the steel is copper bearing carbon steel, structural grade, except for the material in the north truss of Span 10 and the adjacent cantilever arm over the river. Owing to the horizontal curvature in the deck over this span, the north truss is loaded much heavier than the south truss. In order that the members of the north truss might be kept to approximately the same size as that of the corresponding members of the south truss, copper bearing silicon steel was used for them.

The deck, which is a steel grid floor,  $4\frac{1}{4}$  in. in depth filled with concrete, consists of two 34 ft. roadways with a 2 ft. wide raised center strip, 1 ft. high, and a 5 ft. sidewalk and railing on each side making a total width of 82 ft. overall.

**Railing.**—The entire railing on the superstructure and on all of the ramps on the approaches is of hollow steel tube construction. The upper rail being a 5 in. by 4 in., the lower rail a 4 in. by 4 in., and the spindles  $2\frac{1}{2}$  in. square, tubing.

The spindles are spaced approximately  $5\frac{1}{2}$  in. on centers and are welded to the top and bottom rail. The railing panels are approximately 6 ft. in length and were completely shop fabricated and bonderized before they were shipped.

The under side of both the top and bottom rail at each end is cut out so that these panels can be dropped into place between the steel posts and supported on lugs welded to the posts.

The main posts, which occur at the panel points of the trusses, are 20 ft. apart and are 1 ft. 6 in. long, and  $10\frac{1}{2}$  in. wide. The intermediate posts are 8 in. square. Both the main and intermediate posts are formed of steel plates and are riveted to the fascias. The entire railing is of copper bearing steel.

**Drainage.**—The roadway surfaces are built without crown and are flat in the transverse direction except where they are tilted to provide super-elevation around the various horizontal curves. Water, therefore, generally drains longitudinally along the bridge and is collected in cross drains. These drains consist of a deck casting or welded assembly providing two lines of staggered oval holes through which the water drops. The water is guided into wrought iron or copper bearing steel troughs by a complete system of copper flashing designed to give full protection to all parts of the structure.

On the main superstructure, the water is carried from the cross troughs to hoppers on tops of the piers in similar open troughs built parallel to and behind the lower chords of the trusses. From these hoppers the water drops through cast iron pipes built inside of the hollow piers and underground to storm sewers.

On the approach structures, the water is carried by the cross drains to small hoppers and then drops through copper bearing steel pipe downspouts to the ground surface and then through cast iron pipes to the storm sewer. The downspouts and drains vary in size from 8 in. to 12 in. in diameter.

**Expansion.**—In addition to the longitudinal movements due to changes of temperature, relatively large movements are caused by moving loads applied to the cantilever trusses. In consequence it was necessary to provide for total movement in the floor between the various sections of the continuous cantilever trusses, amounting to as much as 16 in. in the most extreme case. Since the expansion dam also acts as a cross drain, additional space was required for drainage and provision was made for a total movement of 19 in. On the main superstructure conventional finger castings are used for the roadway and sliding plates for the sidewalk decking.

On the east approach column and girder construction expansion dams were flame cut from  $2\frac{1}{2}$  in. thick steel plates. On certain other approach structures where the movement was very small, sliding plate and angle joints were used.



*Deck Construction. Filling Steel Grid Floor With Concrete. Note Railing Design and Center Curb Forms.*



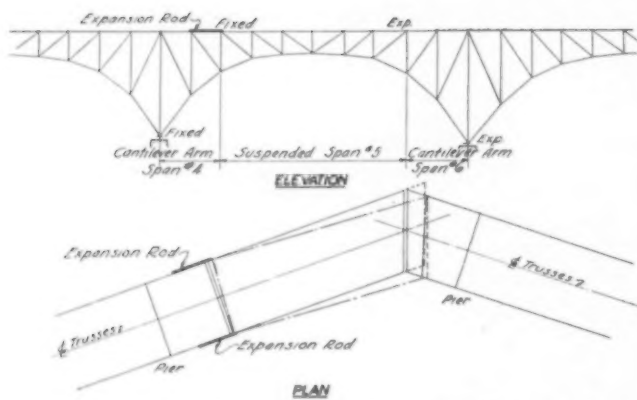


Diagram Showing Method of Handling Expansion on a Curved Section

Normal position shown ———  
 Deflected position (when both deflections are in same direction) if trusses were free to move laterally shown - - - -  
 Actual deflected position shown — - - - -

In general expansion of the railing is provided by allowing the railing panels or rails to slide through slots into the adjacent large posts.

The most interesting and difficult expansion problem occurred at the east end of suspended Span 5. Owing to the horizontal curve in the alignment of the bridge extending over Span 6 and most of Span 5, there is an angle of slightly more than 8 deg. between the longitudinal center lines of these two spans. In consequence longitudinal movements of the two spans result in a relative lateral movement which must be provided for at the expansion joint. At the same joint, however, it is necessary that resistance to lateral forces, due to wind and centrifugal action, be provided. This makes it impossible to provide free lateral movement. The problem was solved by providing pin connections for the far end of suspended Span 5 and holding the pins with tie bars designed to provide the necessary changes in length required by the horizontal rotation of the span and at the same time provide the necessary resistance to lateral forces.

**Painting.**—All of the steel in the entire project is being painted with two shop coats and two field coats of paint. The vehicle for the shop coats is a modified glycerol phthalate resin varnish reinforced with a phenol-formaldehyde tung oil varnish, in such proportions as to assure maximum durability, adhesion and impermeability of the film.

The pigment is composed of 50 per cent pure zinc chromate and 50 per cent iron oxide. The two shop coats are identical except for color. The second coat being slightly darker than the first coat due to the addition of a small amount of lamp black to this coat. The vehicle for the two field coats is the same as for the shop



Portion of Main Avenue Bridge West of Cuyahoga River.

coats and the pigment is aluminum paste. These two coats are also identical except for color. The change in color was obtained by adding 4 oz. of Prussian blue in oil to each gallon of first coat paint.

**Lighting System.**—The Lighting System on the main bridge structure consists of 10,000 lumen sodium lamps mounted on standards, along the outside curbs, with brackets extending about 8 ft. out and over the roadways. On the approach ramps where there are no sidewalks the lighting standards are welded to the tops of the intermediate railing posts. The mounting height of the fixture in all cases is 25 ft. above the roadway surface. The standards are made of No. 3 gauge copper bearing steel and are of square tapered design varying from 8 in. square at the bottom to 5½ in. square at the top.

The system consists of two independent units fed from two substations, one located at either end of the bridge. Each unit consists of two circuits for convenience marked Circuits A, B, C, and D. This arrangement provides for the operation of circuits A and C as "All Night" circuits and the operation of B and D circuits as "Part Night" circuits. Full automatic control



West Approach From Lanes to Detroit Superior Bridge.

is provided by photo-electric relay in combination with other relays and a time switch so that Circuits B and D are adjustable from full time to any desired period.

In general, with Circuits B and D out, Circuits A and C provide alternate lighting in staggered arrangement supplemented by normal lighting at locations requiring particular surface brightness during all periods.

### Cost and Time Schedule

As previously stated the Board of County Commissioners received an offer from the Federal Emergency Administration of Public Works to aid in financing the Main Avenue bridge project and accepted such offer in October, 1937. Under the terms of this offer or grant the project at the east approach was to terminate at West 3rd Street and the city of Cleveland was to build the connecting link from West 3rd Street across the railroad tracks to the Lakefront Road. However, in January, 1939, the Board of County Commissioners filed an amendatory application with the Federal Emergency Administration of Public Works requesting a modification in the scope of the project to permit the county to build this connecting link and include it under the terms of the original docket.

On May 15, 1939, the Board received a superseding offer from the Federal Emergency Administration granting the requested change in the scope of the project.

The portion of the project included under the original docket was opened to traffic on October 1, which is less than two years from the time the original offer was accepted.

The connecting link or Lakefront Road ramp included

TABLE I

Contract No.	Name of Contractor	Description of Work	Amount of Contract
1	The Harris Wrecking Co. of Cleveland.....	Wrecking buildings .....	\$ 126.00
2	The Lombardo Bros. Construction Co. of Cleveland .....	River piers Nos. 8 and 9.....	213,160.00
3	The A. J. Forschner Construction Co. of Chicago .....	Land piers Nos. 0-1-2-3-4-5-6-7 and 10.....	309,999.00
4	The R. C. Mahon Company of Detroit.....	Steel superstructure (pier 0 to 10).....	1,419,370.00
5	The A. Macdougall Company of Cleveland....	Field office .....	1,923.00
6	The Sam W. Emerson Company of Cleveland..	West approach (pier 0 to W. 32nd St.).....	1,027,232.00
7	The Sam W. Emerson Company of Cleveland..	East approach (pier 10 to W. 9th St.).....	488,727.00
8	The Lombardo Bros. Construction Co. of Cleveland .....	East approach (W. 9th St. to W. 6th St.).....	173,917.00
9	The National Engineering & Contracting Co. of Cleveland .....	East approach Lakefront ramp (W. 9th St. to W. 3rd St.).....	376,495.00
10	The Martien Electric Company of Cleveland..	Lighting .....	69,300.00
11	The National Engineering & Contracting Co. of Cleveland .....	East approach Lakefront ramp (W. 3rd St. to Lakefront Road).....	854,866.00
12	To be awarded.....	Lighting Lakefront ramp (W. 9th St. to Lakefront Road).....	*20,000.00
Total .....			\$4,955,115.00

\*Estimated.

in the superseding offer will be completed by June, 1940.

In order to complete the project within the time specified in the PWA grant it was necessary to break the project up into a number of contracts so as to have contractors work in as many places as possible at the same time without interfering with each other.

To date a total of eleven contracts have been awarded and one more on the Lakefront Road ramp is to be awarded.

The list of these contracts is given in Table I.

The total estimated cost of the entire project is \$7,200,000.00 which includes besides the contracts listed, an item of \$1,620,000.00 for right-of-way and an item of \$624,885.00 for engineering, inspection, and all other miscellaneous costs.

The plans and specifications for the entire project are being prepared in the County Engineer's Office under the supervision of John O. McWilliams, County Engineer, Cuyahoga County, Cleveland, Ohio.

The Bridge Engineer is W. E. Blaser; Chief Designing Engineer, Fred L. Plummer; Resident Engineer, Ralph W. Deitrick; Chief Resident Engineer Inspector for PWA, W. E. Janney.

The owners are the Board of County Commissioners of Cuyahoga County: Joseph T. Gorman, John F. Curry, and James A. Reynolds. Until the time of his death Dr. Wilber J. Watson was the Consulting Engineer on the project.

## PROGRESS IN SURVEYS FOR FUTURE HIGHWAY PLANNING

Surveys to guide the planning of future highway improvements are progressing rapidly in 46 states and the District of Columbia, according to the 1939 annual report of Thomas H. MacDonald, Commissioner of the Public Roads Administration of the Federal Works Agency. These surveys, jointly financed and conducted by the Road Administration and the state highway departments, include complete inventories of all rural roads and detailed studies of highway traffic, and highway finance.

The report states that one of the most generally useful products of the planning surveys is a series of large-scale state and county maps. The county maps, generally on a scale of 1 inch to 1 mile or greater, show, in addition to transportation facilities, all physical features and man-made improvements, and will form the first up-to-date and comprehensive series of county maps ever made. At the end of the year there had been approved 2,962 sheets

covering 1,924 counties, approximately 70 per cent of the total to be completed. Other series of maps to be drafted on the base maps show highway and other transportation systems, bus and truck routes, postal routes, school-bus routes, and traffic volume.

The 1940 Federal census will be more complete because of this mapping work, according to the report. For the first time the boundary limits around the settled areas of unincorporated urban communities of 800 or more population have been established in 29 states, making possible census reports for such communities.

Field surveys, which form the basis of the map work, and also an inventory of the present extent and condition of all rural roads, have been completed in 43 states, covering an aggregate of 2,748,853 miles, the report states.

In cooperation with the Association of American Railroads pertinent facts relating to rural and urban grade crossings are being supplies. This information will be combined with data from a field inventory of the crossings and with traffic counts to develop new improvement programs in which first attention will be given to the most dangerous crossings.

Field work on the traffic surveys has been completed in all but 9 states according to the report. At 3,237 stations the weights of trucks, commodities carried, and other data were recorded for thousands of trucks and truck-trailer combinations. Information on the weights and dimensions of busses and number of passengers carried was also obtained.

At the end of the year 411 automatic traffic-recording machines were in operation, counting and recording the number of vehicles passing hourly. Installed at strategically located points, these machines provide a long-period record of traffic volume. Supplementing these permanently located machines are portable traffic counters, used to take short traffic counts at many different locations.

The financial surveys consist of the collection and analysis of information regarding the ability of the state to finance its highway program, the report states. Data obtained from 650,000 personal interviews with vehicle owners and operators will show the relative use of the rural highways and streets by rural and urban residents. Analysis of more than 3,300,000 questionnaires will show the amount of gasoline taxes and license fees paid by residents of cities, towns, and rural areas. A study of road life will make it possible to estimate the amount and cost of highway replacement and construction that will be required each year in the future.



# RECORD ROAD JOB IN SOUTH DAKOTA

*14.8 Miles of 20 Ft. 9-2-4 Concrete  
Slab Completed in 31 Paving Days*



*View of the Work from the Top of the Paver.*

ON Nov. 7, 1939, the South Dakota Highway Commission accepted the completed contract of 14.8 miles of concrete paving with 8-ft. stabilized gravel shoulders which terminated a record completion for work of this type in this section of the country. This completes the hard surface highway from Sioux Falls, S. Dak., to Sioux City, Ia. The contract for paving on U. S. Highway 77 from Beresford, S. Dak., south, was awarded on July 29, 1939, to the Northwestern Engineering Co. of Rapid City, S. Dak., of which Morris E. Adelstein is President.

The contract consisted of 173,976 sq. yd. of reinforced concrete paving, 18,000 cu. yd. of earth shoulders, and 30,323 tons of stabilized gravel shoulders. The construction schedule of the highway department for this project carried the completion over to the spring of 1940. However, it was the aim of the contractor to finish the work during the 1939 construction season. This problem was met by placing a large amount of equipment on the project and planning a construction schedule so that each operation would tie in with the contractor's schedule for completion.

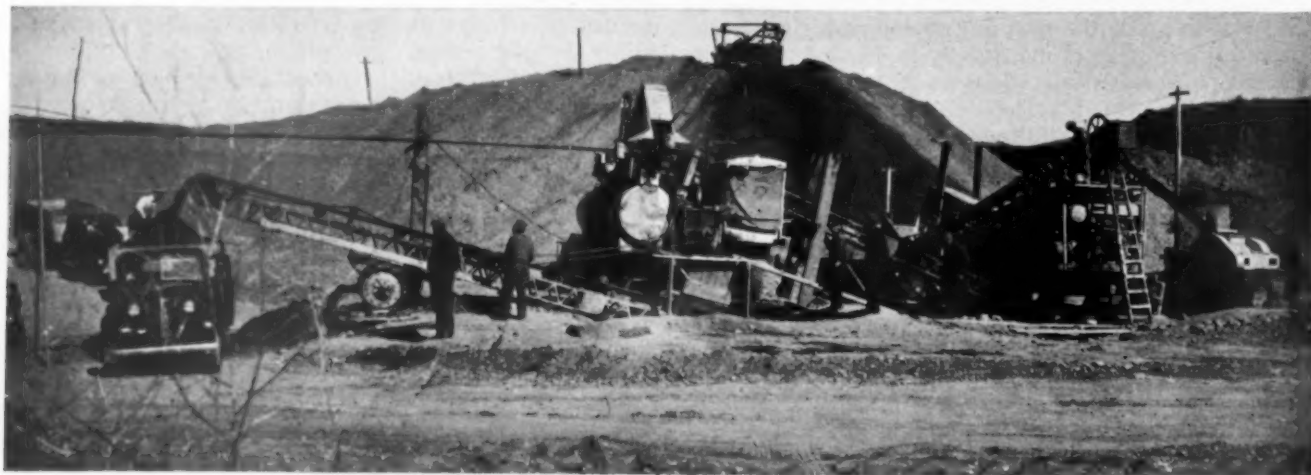
The contractor moved in on the job on Aug. 10th, and after the usual preliminary work, started actual paving operations on Aug. 23rd and completed the 14.8 miles in 31 paving days, maintaining an average of 2,522 lin. ft. of 20-ft. 9-6-9 slab per day. The Northwestern Engineering Co. started working two 7-hour shifts per day, which were cut to two 6-hour shifts, then to two

5-hour shifts, to meet with the changing weather conditions and the shorter daylight hours. Even with these shorter hours, the contractor was forced to use artificial lighting towards the close of the paving operations.

The concrete was completed on Oct. 3rd, after losing several days for rain and cold weather.

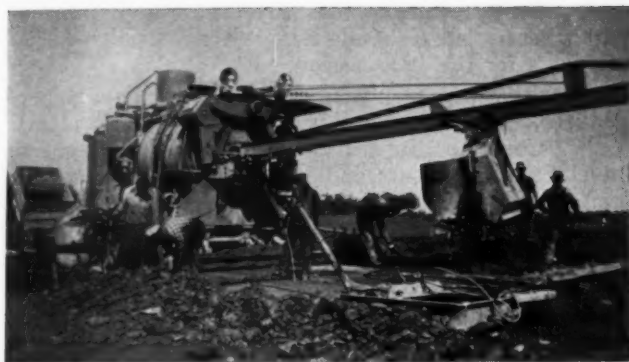
In maintaining the high daily average, three exceptionally large pours were made: 3,460 lin. ft. in 14 hours, 3,164 lin. ft. in 12 hours, and 2,796 lin. ft. in 10½ hours. The concrete paving was placed on a new grade partly constructed the previous year and finished in the early spring of this year. The grade was built somewhat high and had a light covering of traffic service gravel to allow traffic to use the road so that the new grade would have the proper settlement and compaction before the construction of the concrete paving.

**Grading Operations.**—The contractor's rough grading operations were accomplished with an Allis-Chalmers tractor and a Lakewood scarifier, together with a No. 12 Caterpillar auto patrol; at times an RD-7 Caterpillar tractor with an 8-yard LeTourneau was used. The form trench was then cored out with a Carr form-grader and the forms set and tamped into place with a Jaeger form tamper. The fine grade operations were performed with the use of an R-B finegrader equipped with a cross-over bridge for the use of the hauling units. The grade was then rolled with an 8-ton Austin-Western roll-a-plane roller.



*View of Crusher and Stabilising Plant Used to Produce Material for the Stabilized Gravel Shoulders.*





*Koehring 34-E Paver Dumping Concrete on Sub-Grade. Koehring Strike-Off Attachment in Foreground Used to Strike-Off Concrete.*

**Paving Operations.**—For the paving operations the contractor used a Koehring 34-E paver equipped with a Cleveland trail-grader. As the South Dakota specifications require mesh reinforcing, the paver was equipped with a Koehring strike-off attachment that would strike the concrete off 2 in. below the top of the pavement surface prior to placing the mesh reinforcing. The rest of the concrete was then placed and struck off and finished with a Jaeger type D finishing machine equipped with two Mall vibrators for vibrating the concrete at the side of the forms at the expansion and contraction joints. After the second pass of the finishing machine the center longitudinal joint was cut by a joint cutter of the contractor's own design, and the steel joint caps put in place. The slab was then finished with a Koehring longitudinal finishing machine, and after two beltings the concrete was covered with burlap. After the 12-hour wet burlap cure the burlap was removed and the slab then covered with Sisalkraft paper blankets for a final 12-hour curing period. The paper was then removed and the joints were poured and sealed with an asphaltic joint filler.



*R-B Finegrader with Truck Using Cross-Over Bridge.*

The only water available was at an artificial lake located five miles from the south end of the project and ten miles from the north end, and about one-third of a mile off from the project. This necessitated the using of two triplex pumps, pumping the water to a point six miles towards the north end of the project, where a reservoir was made and water pumped from there for the rest of the job.

Each piece of machinery was equipped with its own lights and the paver was equipped with a 4000-watt plant. The rest of the project was lighted with a 10-kilowatt light plant mounted on pneumatic tires, and equipped with reels of wire that could be strung out along the slab.

**Handling the Aggregate.**—The South Dakota State Highway Commission required three sizes of stone: No. 1, graduated from 2½ in. to 1¼ in.; No. 2, 1½ in. to ¾ in.; No. 3, ¾ in. to ¼ in.; and the fine aggregate. Handling these four sizes of aggregate necessitated the use of two Butler bins and scales. The material was unloaded and handled with a Koehring 702 crane equipped with a 2-yd. material handling bucket. The cement for the project was furnished in bulk by the South Dakota State Cement Plant, located at Rapid City, S.



*View Showing Section of the Finished Fine Grade.*

Dak. The material was hauled from the batching plant to the paver with approximately 35 new Ford and Chevrolet 2-batch trucks.

**Earth Shouldering Operations.**—When approximately 10 miles of the concrete was completed, the contractor started his earth shouldering operations. This consisted of water-compacted dirt, which operations were carried on with an RD-7 and 8-yard Le Tourneau and an Austin-Western "99" patrol. The dirt was then watered and rolled with a sheeps-foot roller and a steel roller. This compacted dirt was then cut to grade with a No. 11 Diesel auto patrol, and a final rolling operation was done with an 8-ton Austin-Western roller. The finished earth shoulder grade was 3½ in. below the top of finished concrete.

**Constructing Stabilized Gravel Shoulders.**—When



*Jaeger Type D Finishing Machine with Two Mall Vibrators Mounted on Same.*



*Section of Finished Slab.*

approximately five miles of the earth shoulders were completed, the Northwestern Engineering Co. started their stabilized gravel operations. The contractor obtained his gravel from a pit located  $\frac{3}{4}$  mile from the project and 3 miles from the south end. The gravel had enough clay mixed with it in the natural formation to give a P. I. of 5.8, so that it was not necessary to add any more clay. The gravel had to be put through a crushing plant and then into a stabilizing plant, where 7 per cent by weight of water was added. The contractor used a Cedar Rapids traveling plant as a stationary plant for the mixing operations. The mixed gravel was then hauled to the road. The gravel shoulder was placed in two lifts. After laying the first lift it was compacted with a pneumatic roller. The final lift was laid and compacted with a pneumatic and steel roller. In laying the gravel the contractor used two No. 11 Diesel motor patrols. The contractor worked 20 hours a day on the graveling operations, laying the first lift of gravel at night and placing the second lift only during the daylight hours, as only a  $\frac{1}{4}$  in. variation from cross-section on the finished shouldering was tolerated.

At 4:30 p. m. of Nov. 4th the contractor finished placing the last ton of stabilized gravel on the road bed,



*Left to right: Geo. A. Coffey, Field Supt., Northwestern Engineering Co.; Kenneth Benson, Resident Engineer, S. D. State Highway Dept.; J. J. Taaffe, Construction Supt., Northwestern Engineering Co.*

which was just "under the wire," as heavy freezing weather set in that night and the project would have been shut down for the 1939 season.

Supervising the work were G. A. Coffey, Field Superintendent for the Northwestern Engineering Co.; J. J. Taaffe, Concrete Superintendent; Emil Christensen, Gravel Superintendent; and Kenneth Benson, Resident Engineer of the South Dakota State Highway Commission.

## SAFETY EDUCATION DECREASES ACCIDENT RATE OF HIGHWAY EMPLOYEES

Statistics from the Insurance Division of the State Highway Department of Texas show that safety education within the department has effected a marked decrease in the accident frequency rate of employees.

Since the inauguration of workmen's compensation and the accompanying factor of safety training, the accident frequency rate (the number of disabling injuries—injuries resulting in at least one day lost time—per million man hours worked) has dropped from 35.53 in 1938 to 21.62 in the first six months of 1939. The actual percentage of reduction was 39.15.

For the same periods the accident severity rates—the number of days lost per 1000 man hours worked—were 4.31 for 1938 and 2.24 for 1939, making a total reduction of 48.03 per cent.

During 1938 employees of the department worked 15,195,841 man hours or about twice the 7,676,492 worked in the first six months of 1939, yet the lost time injuries for 1938 totaled almost five times as many as for the first six months of 1939. There were 540 lost time injuries with a loss of 65,438 work days in 1938 and only 166 lost time injuries with 17,218 days lost in 1939. Figuring the average wage of all employees at 40c an hour, this indicates a saving of approximately \$50,000 for the first half of 1939 over half of 1938. Hence, safety education, which really just began showing results in 1939, will probably net the highway department a total saving of \$100,000 in that year. These cold statistics leave no doubt as to the value of safety training in working out a successful workmen's compensation plan.

When the legislature passed an act in June, 1937, providing for workmen's compensation insurance for highway department employees, the newly established Insurance Division made prevention of accidents its first duty. As a basis for a safety program it required that all field employees should be trained in first aid. The American Red Cross cooperated by providing schools for lay instructors throughout the state. These instructors, whose regular duties range from engineers to common laborers, have taught the standard first aid course to some 8,000 employees of the Department and about 3,000 employees of contractors, policemen, firemen, deputy sheriffs, ambulance drivers and other members of the public. Each field employee of the Department is required to attend at least one safety meeting each month. Every resident engineer, maintenance foreman and other supervisory employee has established an individual safety council.

When the safety education program was inaugurated, Jan. 1, 1938, records of the department showed in the first month that employees were involved in one accident for each 3,085 man hours worked. Only 12 months later the record showed only one accident per 15,089 man hours worked!



# LANE MARKING BY BROKEN LINES

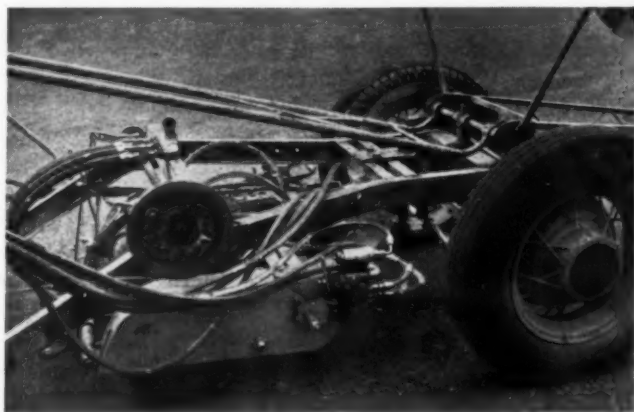
## *Dash Lines Placed Automatically by Regular Paint Striping Machine*

By C. R. WATERS

*District Engineer, New York State  
Department of Public Works, Buffalo, New York*

MANY of the states are now using a broken line for lane marking purposes. Its use is a matter of economy, as the cost of this type of line is much less per mile than a solid line. A mechanism which can be attached to a regular paint striping machine and which provides for the automatic placing of the dash lines, has been manufactured by the Western New York District of the New York State Department of Public Works.

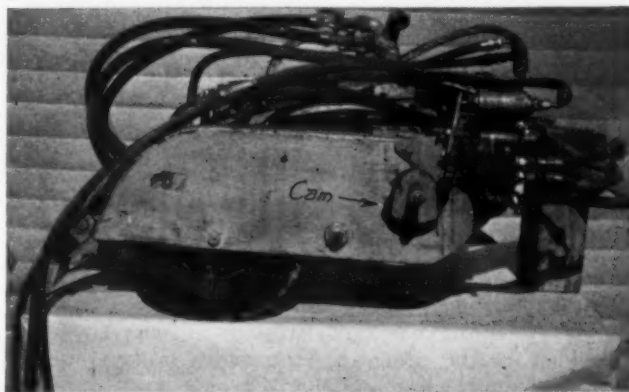
The principle used in this apparatus is very simple. It consists of a valve in the air line which operates the



*Striping Machine in Pushmobile.*

paint nozzle valve. This air valve is opened and closed by a cam operated by a set of gears attached to the axle of the paint application unit.

The gears and cam have been designed so that one complete revolution of the cam provides for a length of 40 ft. on the pavement. In New York State the dash line consists of a 15 ft. paint line and a 25 ft. space, making a total cycle of 40 ft. The cam is made in two sections and is adjustable so that the length of the high point of the cam may be enlarged. This provides for changing the ratio of paint line and space interval, if



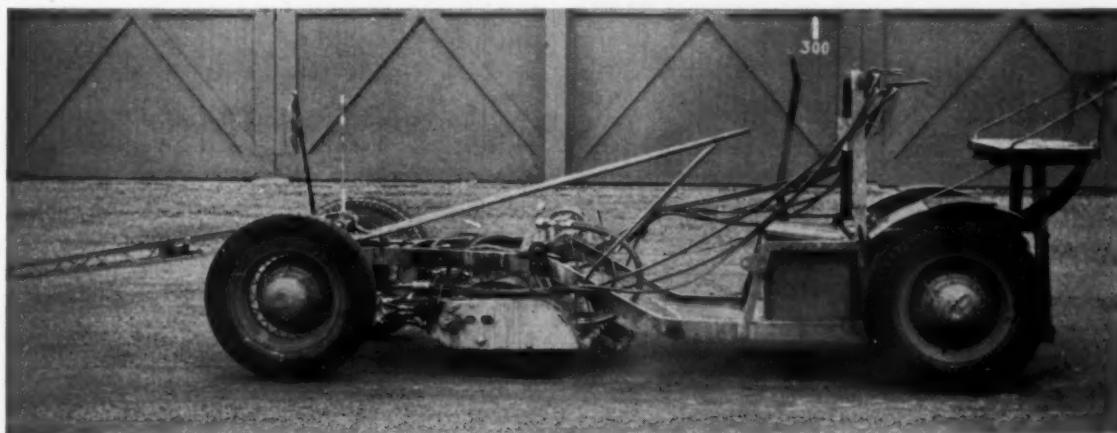
*View of Machine Showing Cam.*

desired. The adjustment of the cam provides for a painted line from 10 ft. minimum to about 25 ft. maximum. The space is variable accordingly, to make a total of 40 ft. A different spacing could be provided by changing the gear ratio.

In New York State during the past year, practically all of the important routes have been painted. The use of the broken line is included in the system of markings established by the State. If properly maintained these lines must be painted once a year, and in some cases oftener.

It was thought that some difficulty might be experienced in repainting the broken line with the automatic equipment, and during the summer some study was given to this point. A solution to this problem was arranged in the following manner:

The original painting unit was equipped with hard rubber tires. Pneumatic tires were substituted and by regulating the air pressure it is possible to duplicate the original length of the dash line. Some repainting work has recently been done and very satisfactory results were obtained. We are now considering a variable gear ar-



*Striping Machine at Hamburg, N. Y., State Highway Shop.*





*Gear Box with Cover Removed.*

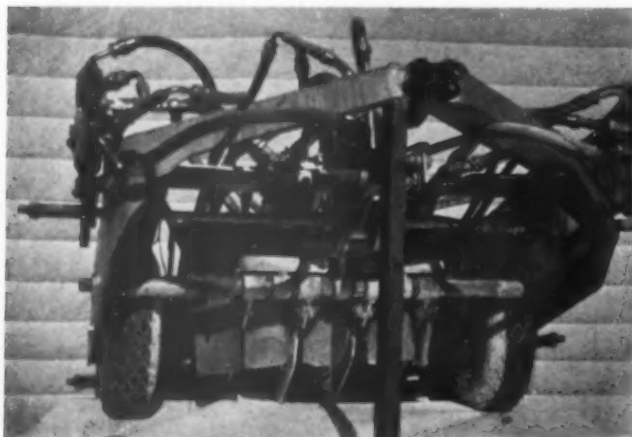
rangement which, if adaptable, would permit of adjustment by turning a speed control hand-wheel.

The system of pavement markings in New York State provides for the use of a 4 in. width broken line, full line, and double line. Rather accurate costs were kept on the work which was performed during the past year on many miles of New York State highways. The average cost for a broken line was \$5.90 per mile; single line \$13.00 per mile; double line \$24.30 per mile. The main item in this cost is paint. It can be seen, therefore, that the use of a broken line provides a considerable saving in cost.

The quantity of work performed by this machine was about the same as that experienced by other states using similar equipment. While it operates at about 10 miles per hour, the maximum day's run was about 40 miles of painting, and the average for the season's work was slightly in excess of 20 miles per day.

The pictures illustrated were selected particularly to show the automatic attachment for producing the dash lines. It was designed and manufactured at the State Highway Shop at Hamburg, New York, in District No. 5, New York State Department of Public Works. The development work in connection with the manufacturing of this pavement marking equipment has been carried on by our regular employed mechanics, under the supervision of the writer.

Arthur W. Brandt is Superintendent of Public Works, and Harvey O. Schermerhorn is Commissioner of Highways.



*Triple Nozzle Paint Striping Machine.*



*White Line Striping on Bituminous Macadam Pavement*

## NATIONAL PAVING BRICK ASSOCIATION TO MEET IN CHICAGO

The 34th annual meeting of the National Paving Brick Association will be held Jan. 30 and 31 at the Congress Hotel, Chicago, Ill. In addition to the business meetings on the first day, the sessions on Jan. 31 will be open to the general public. As the meeting is scheduled during the week of the 1940 Road Show-Convention of the American Road Builders' Association, the many "road builders" who will be in the city are cordially invited to attend the open sessions.

The program includes papers and discussions by prominent engineers and contractors experienced in the use of brick for paving purposes. Important recent developments in manufacturing, in the technique of testing and in construction practices will be presented. Experience with additional mileage of the vibrated monolithic brick pavement—an outstanding development in paving design—including laboratory investigations of its structural strength will be covered. The research bureau of the association, located at the Ohio State University Experiment Station, will make its annual report, containing a summary of the principal research projects. These include several cooperative studies with the U. S. Public Roads Administration and state highway departments.

The unique salvage value and durability of brick in the modernization and reconstruction of pavements will be described by engineers in actual charge of such programs. The adaptability of brick as a heavy duty type to highways that are important in national defense will be a particular theme of this convention.

▼  
**Duke University, College of Engineering**—In accordance with a resolution adopted by the Board of Trustees of Duke University, the Division of Engineering, which was administered as part of Trinity College, was reorganized into the College of Engineering of Duke University. W. H. Hall, Professor of Civil Engineering and Chairman of the Division of Engineering, has been appointed Dean of Engineering. Three curricula in engineering, Civil, Electrical, and Mechanical are offered. The enrollment, which has been set at a maximum of 225, is now 216. The full time teaching staff consists of four men in each of the Civil and Electrical Engineering Departments, and five men in the Mechanical Engineering Department.

# THE ELECTRON-DOMINANCE THEORY OF CYCLES

By HALBERT P. GILLETTE

**D**URING the past six years I have used what may be termed an electron-dominance theory to explain several types of cycles. The theory was first shown to be more than an hypothesis by correlating electric and magnetic cycles with weather cycles and cycles of change in the earth's oblateness. Then it was used to explain several types of phenomena not originally used in developing it, one of the most curious of the latter being cyclic changes in the brilliance of certain lunar craters. Since the sun bombards both moon and earth with electrons, and since electrons reflect light, it follows that any magnetic foci in the moon's crust must vary cyclicly in brilliance. For the same reason the whole moon must likewise vary in brilliance, being brightest per unit of area at full moon. This is the case but it has been explained as caused by a roughness of the moon's surface that was assumed to be great enough to produce more than four times the brilliance per unit-area at full-moon than at half-moon. This roughness assumption is one of the countless *ad hoc* hypotheses with which the observational sciences are afflicted.

It is very fortunate that men instinctively try to explain all phenomena, for scientific theories are the result of such attempts; but it is most unfortunate that the authority of a great name back of some bald assumption often blocks, for a long time, further investigation of the cause of a phenomenon.

The electron-dominance theory states that more electrons (or negative unit-charges) than protons (or positive unit-charges) are emitted by all great celestial bodies, the cause being the conversion of more protons than electrons into radiant energy as a result of gravitational pressure. By aid of this theory I have deduced that the emission both of heat and electrons varies as the mass of the celestial body raised to the  $2\frac{1}{3}$  power. Applying this formula to the heat emitted by the earth and the sun, there is substantial agreement between theory and fact. Another deduction is that the absolute temperature of a main-sequence star varies as its mass raised to the  $5/12$  power; which is also in substantial agreement with facts through a wide range. An incidental but important inference from these agreements is that the cores of the sun closely resembles the earth, and is therefore probably not gaseous but molten. This suggests that the cause of the great sunspot cycle of 189/17 or 11.118 years is rotation of the sun's core in twice that period; for such a rotation of the magnetic poles of the core relative to the stream of galactic electrons would not only explain why alternate peaks of this "eleven year cycle" are greater, but would aid in explaining why the cyclonic and anticyclonic pairs of sunspots reverse their meridional position every "eleven years." This singular reversal has never had even an *ad hoc* explanation, strange as it may seem in view of the universal propensity for explaining.

There is another cycle that most explainers "have fought shy of" ever since it was discovered 175 years ago by Beal. It is the 12-hour cycle in atmospheric pressure. If it were due to gravitation, it would have

far less amplitude and would be surpassed by a cycle of about 12.4 hours due to the moon. A few "ad hocers" have had their fling at it, but the latest investigations show that those "flings" were erroneous. So let the electron-dominance theory have its "fling."

Since, according to this theory, the sun is constantly bombarding the earth with electrons, although in variable numbers, and since the oxygen of the air is magnetic (the most magnetic of all gases but ozone), it follows that about noon the oxygen is most attracted by the solar-electron stream. It also follows that the tidal bulge in the air at noon has a mate 180 degrees or 12 hours away, for reasons analogous to those that explain ocean tides 12 hours apart due to solar gravitation. But since the moon emits very few electrons, compared with the sun, and reflects only a fraction of the solar-electrons, there is but a slight 12.4 hour barometric cycle due to lunar electrons. That the moon does reflect solar electrons and slowly emits those that it has absorbed, is shown by its effects upon radio reception. Stetson found not long ago that these radio effects resemble those caused by the sun.

The moon probably emits electrons of its own, for the emission theory indicates that the number of electrons emitted varies as the cube root of the mass of the planet or star.

More puzzling than the barometric, the electric and the magnetic cycles of 12 hours has been one of 24 hours, for the latter is much more variable at different seasons and in different regions. Study of this variability has led me to ascribe 24-hour cycles to magnetic foci in the earth's crust. Hence there is not merely one 24-hour cycle, but as many such cycles as there are strong magnetic foci in the earth. Theory indicates and facts support the inference that such foci are at the centers of circular arcs of crustal folding, e.g., the Aleutian Island arc. Guided by this, it is feasible to explain regional differences in the phase of the 24-hour cycle, and to show that when and where it coacts with the 12-hour cycle, much greater barometric changes occur at certain seasons. Thus in one region the lowest air pressure occurs at a given hour in midsummer, whereas in another region it occurs in midwinter. Since such conditions repeat themselves at the same hour every four years, there should be a four-year weather cycle, and there is such a cycle. An old Scotch proverb has it that "Leap-year was ne'er a good sheep year." But since there is frequent opposition of weather in northern Europe and in California, I inferred that Januaries of leap-years in California should usually be abnormally warm and dry. I found this to be the case, and that it is strikingly shown in San Diego rainfall during the last 88 years; for while the average rainfall there for January has been 1.87 inches, it has been only 1.41, or 25 per cent less than average in leap-years, and 2.44 inches, or 30 per cent more than average two years later. These amplitudes are enormous, and serve to illustrate the great importance of even short cycles. The coming January falls in leap-year; hence this four-year cycle



will tend to cause a very dry January in California and a very wet one in northern Europe. At least two other important cycles will tend to accentuate these January effects. Last winter the snowfall in the Sierra Nevada Mts. was half of normal. This winter it will probably be still less, and four years hence probably the least that has been recorded by white men.

A common argument against the solar-electron theory of weather cycles has been that, if it were a sound theory, all regions simultaneously should have the same type of cyclic weather changes. Since there are great regional differences it has been inferred that the electron-bombardment theory of weather must be unsound. This inference was not logical; for, by the same sort of reasoning, it might be contended that variations in influx of solar heat do not affect weather because they do not affect it alike all over the globe. Of course an obvious answer to such a criticism would have been that solar heat produces different regional effects depending upon proximity to the ocean and upon topography. A similar answer to objections to the solar-electron theory is had in the regional differences not only as to the proximity of magnetic foci but as to their meridional and latitudinal relationships.

Solar electrons must leave the sun with spiral motions that impart the same magnetic polarity to them as that of the hemisphere whence they escape. Therefore they must be attracted by terrestrial magnetic foci of opposite polarity and repelled by those of like polarity. Hence there results a complexity as to their effects upon the atmosphere that is fully as great as the complexity caused by solar heat.

The grand mistake in meteorology has been the assumption that only solar heat effects need be considered as fundamentally important. More than a century of diligent attempts to unravel weather phenomena have left the great problem of long-range forecasting unsolved. Now comes the solar-electron theory asking as painstaking investigation as the solar-heat theory has received. Is it not common sense to grant that request?

In a forthcoming issue of the *Pan-American Geologist* the cause of arcuate uplifts on the moon and earth will be shown to be caused by cyclic bombardment by solar-electrons. In the November issue of that magazine the same theory was used to explain the two great diastrophic and climatic cycles known as Geological Periods and Geological Eras, the latter being millions of years. This same theory is competent to explain the longest as well as the shortest of terrestrial cycles, ranging from those measured in many millennia to those measured in seconds.



**May Be the Railroads Had a Finger in This—**A law in Texas says that it is unsafe to haul a load of more than 7,000 lb. on a truck, except when the truck is going to a railroad station, when 14,000 lb. is permitted to be hauled as a safe load.



**Indiana State Laboratory Makes 80,077 Tests—**More than 80,000 tests of materials used in construction and maintenance operations on the state highway system were conducted during the past fiscal year by the state highway commission's laboratory. This represented an increase of more than 500 tests over the work done in the preceding year.

## George F. Schlesinger

George F. Schlesinger, Chief Engineer and Secretary of the National Paving Brick Association, Washington, D. C., died after a heart attack at his home Dec. 1. Mr. Schlesinger was well known in engineering and road-building circles throughout the nation. Since September, 1938, he had served as treasurer of the American Road Builders' Association.

Mr. Schlesinger was born in Xenia, O., Dec. 23, 1884. He was graduated from the Ohio State University as a civil engineer in 1907. After practicing civil engineering for six years, he joined the faculty of the Ohio State University engineering department. During the war he acted as engineer on government war construction projects at the Columbus Reserve Depot. In 1919, he became division engineer to the chief engineer of the



George F. Schlesinger

Ohio State Highway Department and was appointed director of the state department of highways and public works in 1925. He resigned this office in 1928 to accept the post with the National Paving Brick Association, which he held until his death. He also edited the association magazine, "Dependable Highways."

Mr. Schlesinger was a past president of numerous engineering associations, including the Central Ohio Section of the American Society of Engineers, the Ohio Society of Professional Engineers, the Columbus Engineers Club and the Mississippi Valley Association of State Highway Departments. The American Society of Civil Engineers awarded him its Wellington Prize in 1931. He was also secretary and treasurer of the Manufacturer's Division of the American Road Builders' Association and a former member of the executive committee of the American Association of State Highway Officials. Among his other memberships were the Highway Research Board, the American Society for Testing Materials, the American Public Works Association, the British Institution of Highway Engineers.

He is survived by his wife, his daughter, Mrs. Henrie John; a grandchild, Frances Rita John; a brother, Dr. Arthur M. Schlesinger, head of the Harvard University history department, and a sister, Mrs. Samuel Heitz of Dayton, O.



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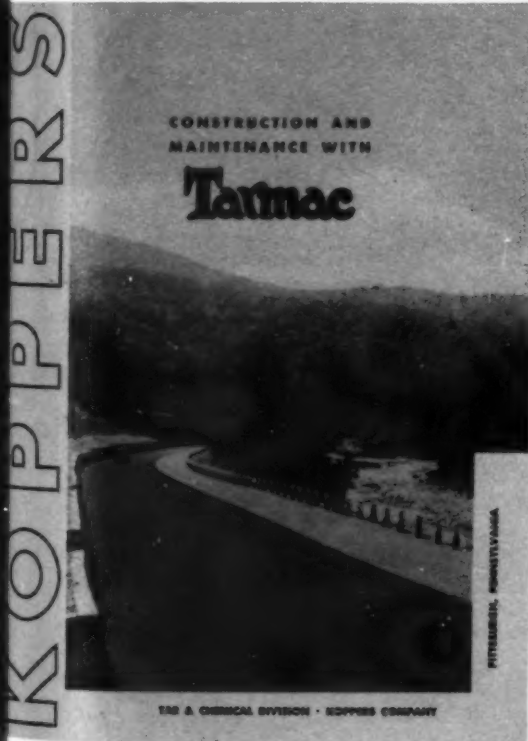
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  - What grade of tar to use for each type of work.
  - What sizes and gradations of stone to use for each type of work.
- Use the postcard to send for your copy. Free.*

SEE OTHER SIDE









READERS OF THE ARTICLE ON STABILIZED BASE CONSTRUCTION IN NORTHERN MISSISSIPPI BY A. B. COVELL IN THE SEPTEMBER ISSUE OF ROADS AND STREETS WILL BE INTERESTED IN THESE PICTURES WHICH WERE SENT US RECENTLY BY T. W. VAUGHAN, PROJECT LABORATORY ENGINEER. THEY SHOW STEPS WHICH WERE NOT PICTURED IN THE ORIGINAL ACCOUNT. FROM TOP TO BOTTOM IN EACH COLUMN THEY ARE:

*The Travelling Mixer at Work  
Blading Out Treated Material  
Discing to Dry Out Excess Moisture  
Smoothing Base with Patrol and Pneumatic Roller*

*Shooting Base with Asphaltic Cement for Finish  
Loading Truck with Crushed Slag for Top Finish  
Spreading Slag to Complete Finish  
The Road Ready to Use*

# OBSERVATIONS BY THE WAY

By  
**A. PUDDLE JUMPER**



☞ The session of the Highway Research Board on highway costs was interesting. Prof. Morrison delivered a paper, as did Bob Winfrey of Iowa State College. Did you ever watch the first round of a boxing match? That's what I immediately thought about after the paper had been delivered. Two schools of thought were sparring after the first few minutes of sizeup.

the sign itself, but each target was fairly well shot up. It may be that this gives us a very good idea for our highway signs, especially in those sections where almost every traveler carries a rifle and uses our signs for training same.

M. B. HODGES,  
Maintenance Engineer, Texas  
State Highway Department.

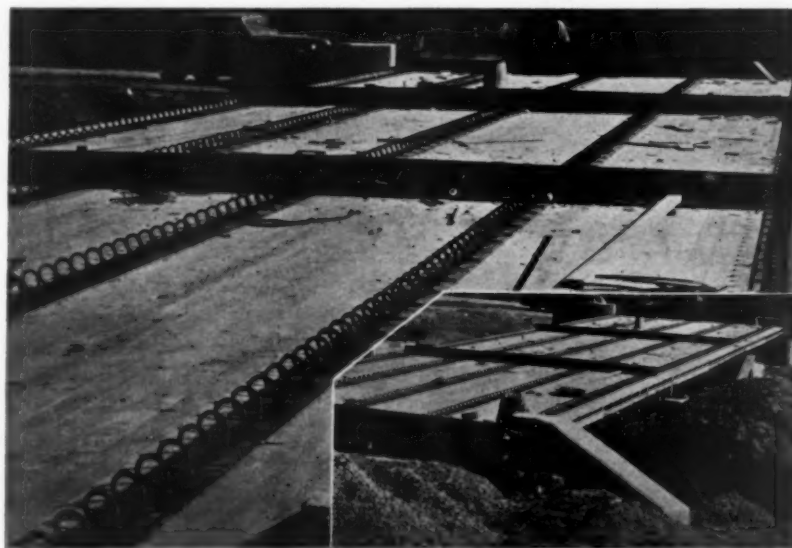


Dear Puddle Jumper:

☞ I note in the recent issue of *ROADS AND STREETS* that A.P.J., which I presume is short for A. Puddle Jumper, is requesting an occasional squib for publication under "Observations by the Way." I am, therefore enclosing a kodak picture which was taken near Highway No. 227 in Brewster County among the Chisos Mountains. I thought possibly that this picture, with an appropriate title, would be interesting to those who are interested in signs. You will note from the picture that the owner of this sign has placed on top of each supporting post a target for those who are prone to take pot shots at signs. The effectiveness of this is not questioned when it was noted there was not a bullet hole in

☞ Seeing a new type of bridge floor reinforcing aroused my curiosity. I thought it would be interesting to

The driver jumped just in time before the truck rolled over down the embankment.



show herewith a bridge of 3 spans of 36 ft. near Hibernia in Dutchess County, N. Y. The regular slab reinforcement is yet to be placed. The spiraled rods are welded to the tops of the I-beams and are claimed to result in a more economical design.

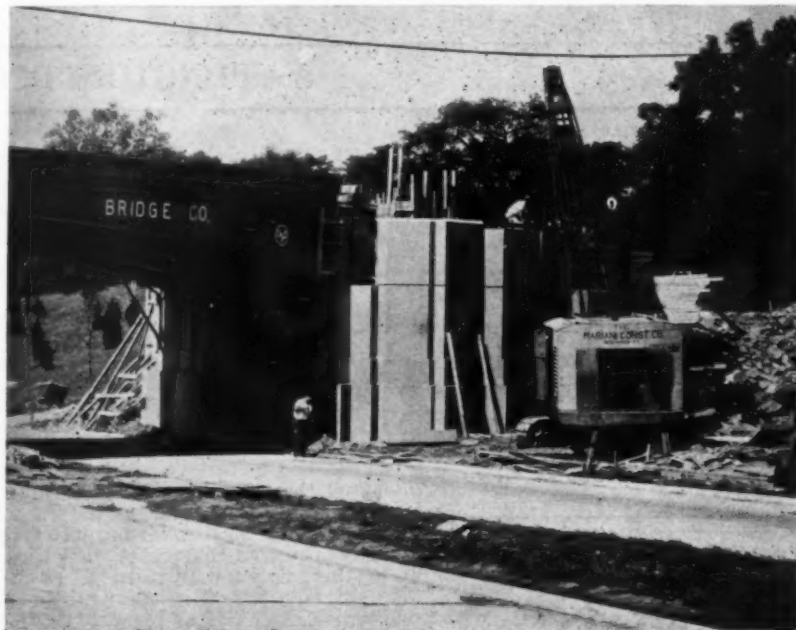
☞ Where profits go. On Nello Teer's job on the Pennsylvania Turnpike this is the result of a driver's miscalculation of footing and side clearance.

☞ Christmas is just around the corner and following it at the next bend is New Year. You who enjoy a "short one" or a quick snort occasionally before driving on a cold day to your brother-in-law's or sister-in-law's home for a good time kindly prepare and mail us your obituary. A few moments now on your part will save us long hours of trudging from hospital to morgue to find out who you were before the hellwater lubricated the steering wheel.



On the Merritt Parkway near Westport, Connecticut, the Mariani Construction Company of New Haven, Conn., are building the Clinton Avenue Bridge. That's not so in-

TO THE EDITOR: The "Ballad of Chas. McGoffus" which appeared in the November issue of *ROADS AND STREETS* originated, to the best of my knowledge, in our Region I head-



teresting in itself, but as you look at the picture herewith you ask where the concrete forms are. That's the interesting part. For backside forms, wood is used as shown. For the face or front forms architectural concrete slabs, very dense in character, and decorative on exposed surfaces are used and held in place by ties from the slab to the poured concrete. The Sextone Company of New Haven, Conn., built these slabs which are a brownish color with a mosaic effect.

• •

Sometimes critical; sometimes complimentary; sometimes giving credit; sometimes not; sometimes taking ideas and rearranging them; sometimes not; sometimes pilfered; sometimes contributed—that's the composition of these pages. A. P. J. lays no claim to complete originality of material published in them. One place he gets some good inspiration, some good cartoon material, or some cleverly written skits is from the Montana Center Line, that peppy sheet of mimeographed multiplicity. His face is red now, and for good reason. The Montana Center Line crowd called his hand. Hereafter he'll have to be more discreet. Don Gough is pretty clever with his pencil and it's hard not to use a cartoon now and then. An italic credit line looks so out of place that A. P. J. hates to put it in type, yet the material is good—so what? Italic line, I guess; ugly or not.

quarters at Richmond, Va. At least it appeared in their "Regional Review" some time ago. Since most of the engineers here in our Washington office are former field men—including yours truly—I was moved to draft the attached by way of an answer and this will soon appear in "Bulletin," which is the official house organ of the Service.

No doubt there are a lot of us Charlies, both present and former, so you are welcome to use this if you care to.

JOHN S. CROSS,  
Senior Engineer, National Park Service, Washington, D. C.

#### More About Charlie McGoffus

Remember that chap named Charlie McGoffus

Who transferred from the field to the Washington office?

Charlie, you know, was a field engineer, A hard working demon with ne'er a peer. A two-fisted, leather lunged regular he-man

Who made up in strength what he lacked in elan.

Well, his brain finally developed a mighty bad quirk

From constant panning by Washington of his paper work.

So the Doc took it out and, believe it or not,

Charlie never called back to get it, just figured so what?

The poor brainless lad went blithely on with his bizz

And was transferred to Washington where he soon was a whizz.

But, alas, poor Charlie, once robust and strong,

Is now haggard and wan, and I think kicks the gong.

His eyes lack former luster, there's a buzz in his ears

Caused by reading reports of the field engineers.

Reports by the thousand, plus letters and such

Have succeeded in grasping him firm in their clutch.

The way jobs come in fair makes Charlie scream

And he wanders around like a man in a dream.

The continual pressure, accumulation of papers

Cause his poor brainless head to cut up queer capers.

Sometimes he sighs fondly at memory's suggestion

Of those wonderful field days (with no indigestion).

The Boss wants to know about the size of that bent,

And the Comptroller is asking where the money has went.

When Bill writes in from the overpass job

That overruns and extras are sure playing hob,

And what are the chances of getting more dough

To push the thing forward before arrival of snow;

Charlie reads painfully, eyes 'bout to pop, When a breathless messenger arrives with a hop

To tell him he's wanted immediately up front

To explain, if he can, some construction field stunt.

Then the phone lets go with a series of jangles—

A long distance contractor with more "extra" angles.

Thus goes the day with its cares and its strife

And along in the evening a frantic call from the wife,

"The dinner is ruined, why don't you come home?"

He takes it in silence, but cusses the phone, Piles up the papers and staggers to rise— Holds to the desk due to spots 'fore his eyes.

This, my friends, is what's happened to Charlie McGoffus

Who transferred from the field to the Washington Office.

And Charlie would gladly take back his old brain

If he could only get out into field work again,

Where he could sit now and then by a nice mountain stream

And cuss loud and long to blow off the steam.

#### L'ENVOI

'Tis a sad fate indeed, but, alas, let's not grieve,

For that erstwhile big he-man is now out on sick leave.



# American Road

WASHINGTON, D. C.

EVERYTHING NEW AT THE

## Down the Road

by CHARLES M. UPHAM

Engineer-Director,  
American Road Builders' Association, Washington, D. C.

### PLOTTING PEACE, PROSPERITY AND PROGRESS

This morning I spent some time examining two maps. One, clipped from a newspaper rotogravure section, showed the parts of Europe directly affected by the newest edition of age-old war; the other a large scale map of the United States of America. The European chart is dotted with explanatory texts. "Allies expected to attack on this frontier." "4,000 killed by bombings in this capital." "British mine blockade against U-boats." The gaily colored and illustrated American map tells a different story. Designated on its surface are national parks, carnivals, winter havens, state fairs and localities with special allure for the hunter and fisherman. Battlefields are also indicated on this map, but they are those of Gettysburg, Bunker Hill and other sites of long-past wars.

Ex-Kaiser Wilhelm, a recent news dispatch informs me, now spends much time sticking pins into his map of Europe to mark the progress of the various armed forces. The average American also spends much time with a map of his country. He is plotting the best way to "see America first" with the time and money at his disposal. While uniformed troops march over the roads of Europe, America's highways are crowded with armies of tourists. Automobiles and trailers roll over the thoroughfares, instead of tanks and motorized military units. American women and children may evacuate the cities, but their husbands and fathers usually accompany them. Their destinations are not safety zones or neutral territory, but points of particular scenic, historic or recreational interest. While European armies leave

death and destruction in their wake, the American tourist army brings prosperity and progress to the communities through which it passes. European nations pour their funds into warships and airplanes, bombs and bullets. American tourists buy gas and oil, hot dogs and root beer. Merchants of munitions are enriched by wartime expenditures, but the peacetime caravan puts money into the pockets of the butcher, the baker and the automobile maker. War abroad means an important increase in the number of tourists who will spend their recreation time and money within the borders of the United States.

There is, unfortunately, one inevitable parallel between the Europeans marching on the road to war and the Americans starting on a motor trip over our highways. Civilians are being killed at a shocking rate in both cases. The unnecessary slaughter of American motorists exceeds 100 deaths a day. Peace pleas have thus far proved ineffectual to stop the murder of non-combatants in Europe. We, however, have at our command a most effective and certain method of decreasing our highway-accident fatalities. We can, with a far lower expenditure than the annual cost of war, eliminate the road hazards responsible for these accidents and build modern roads to safely and conveniently accommodate all our automobiles. While Europe exhausts its manpower and resources in a major war, the United States can turn its energies to the construction of highways to insure the trade, transportation and tranquillity of future Americans.

### EVERYTHING NEW AT THE ROAD SHOW-CONVENTION

Delegates to the 1940 ARBA Road Show-Convention will preview a vast array of road-building equipment never before placed on display. Developed during the past two years, many machines and materials will be nationally introduced for the first time in Chicago's huge show place, the International Amphitheater. Modernized models of road-proved equipment will also bow to the applause of Road Show "first nighters." This New Year introduction of new machines and materials to the road builders was disclosed when plans for Road Show exhibits were announced by manufacturers.

Equipment manufacturers are confident of a continuing and increased highway program. This is conclusively signified by the amount of Road Show space allocated. Indications are that the 1940 Road Show will embrace a gross area of more than 265,000 square feet. Manufacturers are freely predicting that the 1940 Road Show will be the largest and most successful exposition in the history of the ARBA. The International Amphitheater is admirably appropriate for the staging of a comprehensive exhibition of road-building equipment.

More than 40,000 road builders will be on hand to preview equipment designed to build tomorrow's motorways. The entire road-building world will be represented. All of the United States and 36 foreign nations will send delegates to discuss and solve the increasingly complex problems of road administration, planning and building.

Roads for national defense will take the convention spotlight as officials of the War Department mount the speakers' rostrum to present their views on highway planning and building. Thomas H. MacDonald, commissioner of the Public Roads Administration, will report on the highway planning survey that the agency he heads is undertaking with the co-operation of 46 states. Administrator John Carmody of the Federal Works Agency will discuss the future of road building in America. Many other nationally known good roads proponents will speak at Convention sessions and at the annual ARBA banquet.

The theme of the 1940 ARBA Road Show-Convention, "Roads Rule the World," will be literally true, January 29-February 2, as the road-building industry and profession occupy the headlines in the nation's news.



# Builders' Review

DECEMBER, 1939



## ROAD SHOW - CONVENTION

### With Our State Groups

#### ILLINOIS

"Public Relations" keynoted the second fall meeting and dinner of the Illinois Road Builders' Association at the Palmer House, Chicago, November 30. General Hugh S. Johnson, nationally known radio and newspaper commentator, discussed the military values and peacetime needs of Illinois roads in a banquet speech titled "Hell on Wheels." Many newspaper publishers and editors were banquet guests. Robert Kingery, general manager, Chicago Regional Planning Association, spoke on "Super-Highways—From Conversation to Blueprints" at the luncheon-meeting of the ARBA affiliate. Highway department officials from Illinois, Wisconsin, Michigan and Indiana were honor guests. Engineer-Director Charles M. Upham, Assistant Engineer-Director William C. Slee and General Counsel Francis J. Kelly of the ARBA discussed the national highway picture. "Highway Construction for 1940" was covered by C. M. Hathaway, construction engineer, Illinois division of highways. IRBA President Herbert R. Anderson, president of the ARBA Highway Contractors' Division, presided at the banquet. Luncheon chairman was IRBA Vice-President Otta A. Milburn.

#### MAINE

William C. Slee, assistant engineer-director of the American Road Builders' Association, addressed the meeting of the Maine Good Roads Association in Portland, December 8. A comprehensive business meeting was followed by varied entertainment.

#### MINNESOTA

The Minnesota Highway Development Association is sponsoring the cause of the farm-to-market road improvement program. According to Ernest W. Moeller, executive secretary of the ARBA affiliate, the association hopes to inspire the creation of an increasing number of good roads groups, to mobilize these forces and direct them in a single statewide program endorsed by all communities.

#### PENNSYLVANIA

The Associated Pennsylvania Constructors staged its annual banquet and

convention at the Penn-Harris hotel in Harrisburg, December 13-15. Speakers included H. S. Fairbanks, United States Public Roads Administration, on "Highway Planning and Its Effects"; Charles M. Upham, ARBA engineer-director, on the new interregional highway program; William C. Slee, ARBA assistant engineer-director, on the new ARBA Airport Division; Francis J. Kelly, ARBA general counsel, on the federal Wage-and-Hour Law; Herbert R. Anderson, president, ARBA Highway Contractors' Division, on the activities of his section, and Robert E. Harper, ARBA director of public relations, on good roads publicity. The banquet program featured short talks by Governor Arthur H. James of Pennsylvania, Pennsylvania Secretary of Highways I. Lamont Hughes and Judge Howard W. Hughes of the Pennsylvania judiciary. Nationally known stage and radio stars entertained after dinner. Two lettings of the Pennsylvania Turnpike Commission and state highway department projects were held during the three-day conclave. "Highway Builder," official APC publication, published a special issue to commemorate the meeting.

#### DANN O. TABER DIRECTS OHIO PUBLIC RELATIONS

Dann O. Taber has been appointed director of the new public relations division of the Ohio department of highways. Mr. Taber's talents are especially adapted to his new vocation. He has been a trade commissioner in the automotive parts industry and a member of the editorial staff of the Penton Company, Cleveland, Ohio, trade paper publishers. He has made highway finance and administration studies for the Portland Cement Association in southeastern New England and mid-West states, has planned and executed roadside-improvement campaigns and has developed several statewide organizations. Born in Hamilton, Ohio, April 18, 1896, Mr. Taber was graduated from Ohio State University in 1920. He is

a member of Sigma Delta Chi, professional journalistic fraternity.

#### ROAD BUILDERS PARTICIPATE IN CONSTRUCTION CONFERENCE

Charles M. Upham, ARBA engineer-director; Murray D. Van Wagoner, ARBA president and Michigan state highway commissioner, and G. Donald Kennedy, deputy Michigan state highway commissioner, represented the American Road Builders' Association at the recent National Construction Conference. The conference was sponsored by the Chamber of Commerce of the United States at Washington, D. C., November 16-17, to consider opportunities for further accelerating construction as an aid to business recovery. All

divisions of the construction industry, manufacturing, contracting and distributing, as well as professional groups and mortgage financing institutions were associated with the chamber in setting up the conference.

#### UPHAM IS HONOR GUEST AT MEXICAN HIGHWAY OPENING

Charles M. Upham, engineer-director of the American Road Builders' Association, was guest of honor of the Mexican government at the dedication ceremonies for the new Mexico City-Guadalajara Highway, 300-mile link in the Inter-American Highway, which was opened on October 22. Mr. Upham was for several years consulting engineer for the government of Mexico.

## Composite Steel and

# REINFORCED CONCRETE CONSTRUCTION

## for Highway Bridges

By C. P. CUENI

Engineer, Porete Mfg. Co.,  
North Arlington, N. J.

FOR structural members subject to bending and made of fireproof material two distinct systems are generally accepted today. They are: steel and reinforced concrete construction. Reinforced concrete construction has stiffness but has an extra dead load due to the structurally useless concrete under tension, and requires expansive false work for erection. Steel construction is lighter, simple and quick to erect, and must be designed on deflection. The advantages of both systems combined are of greatest importance for bridges where long spans and heavy loads prevail. Stiffness and lightness can best be effected by using concrete in compression and plain steel in tension. These two materials are present in most bridges, for the reinforced concrete floor slab supported by plain steel sections, is used extensively.

If the concrete slab and the steel sections can be combined into one statical unit, a composite section is obtained which not only unites all of the above mentioned advantages of steel and reinforced concrete, but also eliminates all of their disadvantages and saves considerably on structural steel.

The problem is to find a simple and positive shear reinforcement to transmit the horizontal shear from the steel section into the concrete slab.

A composite construction which has such a shear reinforcement consists of a structural steel section, a reinforced concrete slab, and a spiral arc welded to

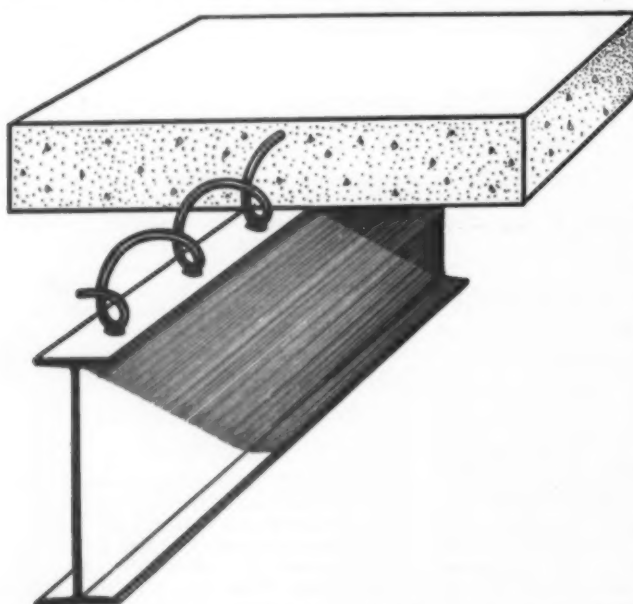


Fig. 1.—Spirals to Be Embedded in Reinforced Concrete Floor Are Welded to Top Flange of Supporting Floor Beams

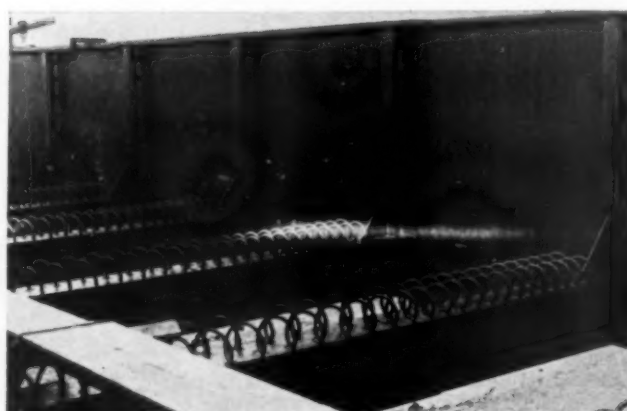


Fig. 2—Showing Spirals Welded in Place.

the steel section and embedded in the concrete slab, thereby combining three elements into one structural unit (see figure 1). The steel section bound solidly by the spiral to the concrete slab takes all of the tensile stresses, the spiral transmits all of the horizontal shear (not depending on bond) and the concrete slab takes all or most of the compressive stresses, the same as in reinforced concrete construction. The three elements of such a construction, the tension part, the compression part, and the shear reinforcement are neatly separated, and the stresses can therefore be figured accurately.

Numerous tests have shown that the spiral is an ideal, reliable, and effective means for transmitting all of the horizontal shear from the steel section into the concrete slab.

**Design Data.**—The formulae used for the design are the same as generally used in reinforced concrete design, based on the theory of flexure and the assumption that a plane cross-section before loading remains a plane cross-section after loading and that the unit stress is proportional to the deformation. As can be seen from figure 3 the resisting moment of a composite section is the sum of three resisting moments: the resisting moment of the steel in tension, the resisting moment of the steel in compression, and the resisting moment of the concrete in compression. The location of the neutral axis is computed the same way as in any heterogeneous and unsymmetrical beam. The moment of inertia of the composite section consists of the moment of inertia of the tension steel multiplied by  $n$ , plus the moment of inertia of the compression steel multiplied by  $n$ , plus the moment of inertia of the concrete.  $n$  equals the ratio of modulus of elasticity of the steel to that of the concrete.



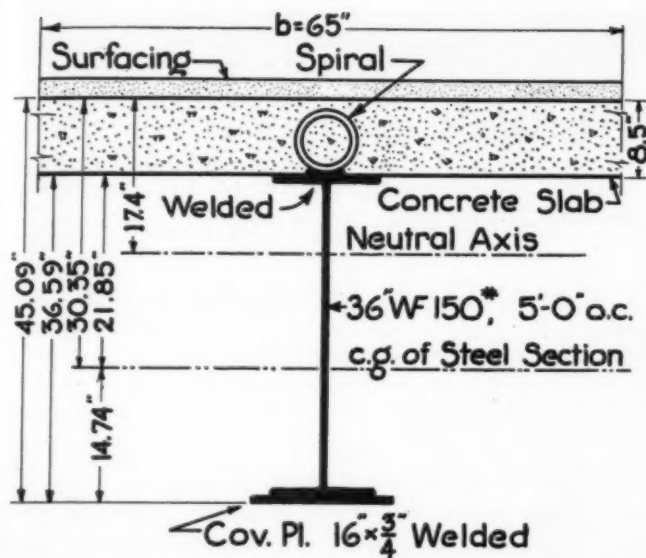


Fig. 3.—Section of Stringer Employing Composite Construction, the Patented Alpha System.

Quite contrary to what is usually done in reinforced concrete design, the moment of inertia of the steel sections about their own axis should not be neglected, because due to the great stiffness, it may be a considerable part of the total moment of inertia.

The end connections usually have to be designed to carry the end shear, and the steel section alone to take care of the vertical shear at intermediate sections. The plain horizontal shear between the steel section and the concrete slab must be transmitted entirely by the welds and the spiral. To compute the horizontal shear per unit of length the generally accepted shear formula is used.

Usually  $\frac{1}{2}$  in.,  $\frac{5}{8}$  in., or  $\frac{3}{4}$  in. diameter round rods are used for the spirals. The pitch (distance between two welds) may vary and in heavy construction 2 or 3 spirals may be required.

As the concrete cannot participate in carrying the load until it has set, the steel alone has to carry the dead load and only the live load is carried by the composite section, unless the steel section is effectively supported during pouring and setting of the concrete. However, initial stresses in the steel should not perturb the designer because it has been conclusively proven by tests that the initial stresses in the steel from whatever cause they may be (load, dead load, shrinkage of concrete, change in temperature, etc.) do not influence the breaking load of a composite section. In some of the tests on pre-stressed beams the initial stresses in the steel were as high as 24,000 lb. per sq. in. without any detrimental effect on the section and its carrying capacity.

It is apparent that such a composite section designed under the assumption that the steel section alone carries the dead load has a considerably higher factor of safety than any standard design.

**Advantages.**—Several advantages are claimed for composite sections for bridge construction. Compared with reinforced concrete construction, less concrete is used and therefore a smaller dead load is obtained; less false work is required and the erection is simpler and quicker; all of which means lower cost. Compared with steel construction, there is considerable saving in steel or with the same amount of steel the span can be increased, which means a saving in cost. The system has less deflection, due to the greater moment of inertia of the composite section. Therefore much longer spans

are possible with the same depth of beam and without exceeding the allowable deflection from live load. For instance spans up to 100 ft. are possible for an H2O loading, using rolled sections as stringers. The bridge will have greater lateral stiffness. Shallower construction is possible with little addition of steel and without excessive deflection. This is important in grade crossing eliminations, where the approaches can be shortened on account of the reduction in depth.

Simplification of design in some long spans is obtained where simple stringers can be used instead of longitudinal plate girders, floor beams and stringers. This effects a considerable saving in steel and connections and therefore in cost.

A bridge for a light loading can be designed and built at no additional cost so that it may later be converted to a heavier loading by merely adding cover plates to the lower flanges. In many cases the strengthening of an existing bridge can be effected more economically by the use of a composite system than by adding new steel.

**Example of Design.**—To illustrate some of the advantages mentioned a highway bridge designed, and soon to be erected for one of the Boroughs of New York City, is compared with plain steel construction. Span, 80 ft.—width, 65 ft. for 3 traffic lanes, in each direction, spacing of stringers, 5 ft. 5 in.—number of stringers, 13—available depth, 4 ft. 0 in.—loading: two 20 ton trucks at a distance of 20 ft. followed and preceded at a distance of 15 ft. by a uniformly distributed load of 800 lb. per ft. of traffic lane.  $M_{DL}$  equals 765 ft.-kips,  $M_{LL}$  equals 886 ft.-kips,  $M_{max}$  equals 1,651 ft.-kips,  $f_s$  (silicon steel) equals 21 kips per sq. in.,  $f_c$  equals 0.8 kips per sq. in.,  $n$  equals 10,  $S$  required equals 944 in.<sup>3</sup>

Designed with the assumption that the steel section alone carries the dead load and the composite section the live load only, a 36 WF 150 plus a plate 16 in. by  $\frac{3}{4}$  in. is required for the Alpha design (see figure 3).

The combined stresses (D.L. + L.L.) in the bottom flange are 20.46 kips per sq. in., in the top flange 19.5 kips per sq. in. The stresses in the concrete (L.L.) are 0.587 kips per sq. in. The deflection by L.L. equals

$$1 \text{ — of span.} \\ 1000$$

The  $S$  required for standard steel construction equals 981 in.<sup>3</sup> due to the heavier section necessary. Therefore, for the bending moment a 36WF 280 is necessary for standard steel construction. However, the deflection

$$1 \text{ of this section due to L.L. equals } 1.81 \text{ in. or } \frac{1}{530} \text{ of span, which is not permissible and a considerably heavier section would be required.}$$

The saving in cost by using the 13 stringers required for the composite system over the 36WF 280 sections required for the standard system was figured to be \$3,756.00.

If the standard system were designed for the same

$$1 \text{ deflection of } \frac{1}{1000} \text{ of the span, the saving by the composite system would be more than twice as much.}$$

The composite construction called the Alpha system, is patented and was originated in Switzerland where today it is used on the majority of highway bridges as well as on many fireproof buildings. Its use has spread to adjacent countries and is already well established in Holland, France and Italy.

# NATIONAL ROAD BUILDING

## *Through the Cooperation of the States and the Federal Government*

By THOS. H. MacDONALD

*U. S. Commissioner of Public Roads, Washington, D. C.*

THE compelling motive that brought the states together in 1914 to form the American Association of State Highway Officials was to secure the recognition of the highway problem and acceptance of financial responsibility by the Federal Government. The plan designed to accomplish these objectives has since been followed for other joint State-Federal undertakings, but the Federal Highway Act of July, 1916, pioneered the way. No worse time could have been found to organize on a nation-wide scale a new and chartless project, for in less than a year the United States became an active participant in the world war. The energies and material resources of the country were mobilized to meet the emergency. The existing highways, without reasonably adequate maintenance, had to serve. Their deterioration under the rapidly multiplying motorized highway transport was appalling. The lack of improved highways where needed seriously handicapped operations and caused extravagant expense.

The end of the war brought the realization that in four short years motorized highway transport had grown to material dimensions, demanding a new concept of highway building on a scale never before contemplated. As a result of extended hearings and consideration, the Congress, in November, 1921, rewrote the Act of 1916 to incorporate the principles which became and have remained, the magna charta for State-Federal cooperative highway improvement through the years now intervening.

The spirit of this 25th anniversary observance is to pay grateful tribute to the founders whose vision created, and whose devoted efforts carried the association successfully through the early years. Time's inevitable toll has included some of the stalwarts; fortunately many remain—some in official life and some following other pursuits. All of these, without a single exception, have held a characteristic point of view. The one tribute of great value that lies within the power of the association to bestow is a record of accomplished worth-while results and the assurance of greater efforts for the future.

### Clearing House Activities of the Association

The association has continuously taken the important task of presenting and supporting before the Congress recommendations for Federal legislation, including road building funds. This activity is generally known. The important function which is not so widely known is the indispensable part the association has taken in the formulation of the methods and policies incorporated in the structure of the Federal highway administration. The association has acted in the capacity of a clearing house to refine State and Federal viewpoints, limitations and objectives, into the sound principles and policies which have been productive of mutual respect and have sustained, with rare exception, cordial cooperative relationships between the highway departments of the States and the Federal Government.

These clearing house activities which go on continuously are so closely integrated with the content of all Federal aid agreements and operations that the spirit

of equally balanced authority, State and Federal, written into the basic legislation, has been preserved intact. This does not overlook, but it does fail to find important, the differences of opinion over details that are inherent in planning and building an average of more than 14,000 miles of roads of all types every year for the past nineteen years. Without the understanding and standards developed through the standing and special committees of the association, it would have been impossible in two decades to complete cooperative road projects of sufficient length to circle the earth eleven times.

### Results of Cooperative Highway Operations

All cooperative undertakings have a time factor, not of delay but of an additional period over that necessary for a single organization to act. The figures just quoted prove the degree to which, in the cooperative highway operations, this additional time element has been reduced to a minimum through the setting up of standards that permit mass production. As an example of these, in 1920 highway bridge specifications were chaotic in their lack of uniformity among the States. A standing committee of the association was appointed made up of competent bridge engineers from the State and the Federal highway departments. This committee has performed a herculean work in developing standard specifications uniform for the nation, which are kept constantly abreast of the advancing technique of bridge design and construction.

The plan of selection and marking of the U. S. numbered highway system came through a joint State-Federal committee, and its administration continues through the executive committee of the association. Here is a remarkable example of a nation-wide service established through cooperation without the necessity of resorting to special State or Federal legislation. The selection and numbering of through routes met the Federal objective of providing for ease of interstate travel without detracting from, but rather enhancing, the importance of the State roads incorporated in the system.

The code of uniform directions and warning signs came from a committee of the association working in cooperation with other bodies interested in furthering the convenience and safety of travel on highways.

The subcommittee on uniform accounting is maturing a manual for uniform fiscal accounting and cost records that is seriously needed. Not until this is completed and universally adopted will it be possible to benefit by comparisons of costs between localities and States or to decide the true costs, or the relative economies between different types of construction. These must rest upon an adequate system of uniform accounting.

The Special Committee on Road Design is earnestly engaged in modernizing basic design principles to serve traffic requirements of the new order. The object of this work is to minimize, and to the extent attainable to eliminate, hazards to traffic safety, and these considerations are ruling. As rapidly as the results of current extensive research upon traffic behavior are reduced to



## You get a Lot More for Your Money than Appears on the Surface in these 1½-ton INTERNATIONALS



THIS PICTURE of the 1½-ton Model D-30 doesn't half do justice to the truck. It gives you a good idea of the modern design of International Trucks, but it doesn't tell you a thing about the amazing economy of the trucks on your job. Drivers and owners can tell you about that.

It takes more than just appearance to deliver International performance. A new line is not just a matter of the calendar with International Harvester. Constant improvements in engineering and construction *make and keep* International Trucks the standard for the industry.

Our constant aim is to give you *hauling value—to make economical performance your lasting source of satisfaction.*

In the popular Model D-30, as in every International Truck from the sturdy ½-ton pickups to the powerful six-wheelers, you get *International* performance. And that's the finest thing that can be said of anything on wheels. International Trucks are rugged, *all-truck* trucks all the way through. They are made for tough jobs and rough handling, and they are built to take it.

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sound conclusions they are being given full weight by the committee. Out of these research studies in traffic behavior there is rapidly emerging new light on necessary minimum requirements for highway design with built-in safety margins. Too many decisions in the past have rested upon the conception of the motorized traffic unit as static when using the roads. This conception must be replaced by the established dynamics of the motor vehicle in motion on the road.

### Continued Cooperation by Public Roads Administration

These examples of the important continuing work going forward under the association's policy of developing standards to lift the technique of engineering and administration to even higher levels required by modern highway traffic are indicative of these facts: First, that all important standards are developed through cooperation between State and Federal highway organizations; second, that the standards enforced on all Federal aid projects have been approved by a majority of the states; and third, that the policy of the Federal administration in all matters of regulations and requirements will continue to seek prior consideration and action by the proper committees of the association, and through the established routine the approval of the association itself.

This reaffirmation of the will on the part of the Public Roads Administration to cooperate with the state highway departments in generous measure, and the accenting of the greatly changed character of today's highway usage, appear now very important for major reasons. At this moment the nation is facing, at home, serious problems within our economic structure, and abroad, a crisis of cataclysmic potentiality to the world's existing order. Adequate highways are an essential element of our national economic and social well being during all ordinary periods, and their importance increases at an accelerated rate through the whole period of a national emergency. If the national defense is involved, needed highways are without price.

Under the present disturbed conditions it is to be expected that the state highway departments would be deeply interested and perhaps a little uncertain as to the future of Federal road policies and programs, and as to the import of the reorganization which transferred the Bureau of Public Roads from the jurisdiction of the Department of Agriculture to the Federal Works Agency as the Public Roads Administration. The statement by Administrator Carmody of the broad-gauged forward-looking general policies under which the Federal Works Agency will operate, effectively disposes of any uncertainty as to the future support by the Federal Works Agency for the road program, but it imposes the responsibility upon the State and Federal organizations to develop a planned and coordinated program with full justification.

### Record of State-Federal Highway Improvement

Without too much statistical detail the past record of State-Federal highway improvement now stands thus:

The Federal aid system of highways first selected totaled 168,798 miles. By September, 1939, this had increased to 226,051 miles—partially by the addition of mileage within the seven per cent limitation, and particularly by the addition of the permissible one per cent increments. Twenty-five states have thus added to the original seven per cent. Not included in these totals are Hawaii, 623 miles, and Puerto Rico, 1,152 miles.

Highway improvement projects on the Federal aid

system from 1917 to 1933, of all types, totaled 121,064—to September, 1939, 150,713 miles of initial construction, and 62,974 miles of second stage improvements to the original projects.

The 121,000 miles initially improved prior to 1933 are then an average of about 15 years old and the standards are of that period.

Since 1933 approximately 30,000 miles have been initially improved on the Federal aid system. In general the standards under which this mileage has been constructed are better, but still deficient, particularly in sight distances, alignment and width, to meet the desirable requirements of modern design.

Approximately 77,000 miles of the Federal aid system as it now stands, have had no improvement as Federal aid projects.

The maintenance inspections made by the Public Roads Administration during the calendar year 1938 covered 139,000 miles on the Federal aid system, and this mileage as a whole averaged a rating of 89.6 per cent on the standard scale. This mileage is classified by surfaced types as follows: low type, 15 per cent; intermediate, 35 per cent; and high type, 50 per cent. This means that on the Federal aid system there is in excess of 70,000 miles of the higher type surfacings as a whole in excellent condition of maintenance exclusive of the mileage of such improvements provided by the states without Federal aid. The state highway departments can well be proud of the record made in maintaining this mileage in service under the tremendous increase in usage.

While secondary roads as a part of the regular Federal aid program have only been included since 1937, together with the use of emergency funds, the initial improvement has been made on projects totaling 28,311 miles. The most important problem now is the wise choice of a system of secondary roads whose improvement may be undertaken in the same orderly manner as has been followed on the original system of major roads.

In the Federal aid program prior to 1933, 6,287 railroad-highway grade crossings had been eliminated. In the period 1933 to 1939, 4,056 eliminations have been added, making the total of 10,343 completed or in process of construction. In addition, warning and protection devices have been or are being installed at 3,053 crossings.

These improvements are not represented to be the sum total of highway works within the nation by any means. During the period 1921 to 1931 the expenditures by the states for construction additional to that included in the Federal aid projects, were in excess of the State-Federal program. In 1920 the registration of motor vehicles reached 9,231,000; that is, motorized highway transport grew to national dimensions during the previous four or five-year period. The maximum production of new mileage was during the period 1920 to 1930. While Federal expenditures increased after 1933, the total amounts expended for new construction on the major roads reached their peak in 1930 and 1931, and have not since that time touched the same level. Thus the larger highway building program of major roads ended nearly a decade ago, and the average motor vehicles in service during that period were not much in excess of one-half the registration of today. Much of our major highway system was built during the period when the speeds of the individual units, the use per year of each unit, and the number of units in operation, were all very much under the figures of today. The standards of road design were geared to these figures, and not to today's requirements.





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● Proper maintenance of roads and streets during the winter months call for prompt removal of ice, if the accident rate is to be held within bounds.

The use of salts, chemicals and alkalies are cheap and convenient means of ice removal—wholly satisfactory except that they often cause scaling and deterioration of unsurfaced rigid pavements.

You can use any of these ice removal materials without damage to brick.

Nor is there damage to brick where these melting materials have been used as an admixture with sand or cinder stock piles.

And, of course, brick best withstands the concentrated chain-shod traffic in snow-rutted roads

or streets. The experience record of hundreds of cities and other road building units and many accelerated tests have definitely established that point.

The cost of upkeep on brick pavements is always low, ranging from negligible to nil.

Brick resists damage from weather, traffic and ice-removal material, and thereby gives smooth, safe passage to any type of traffic at the lowest cost per year of service. National Paving Brick Association, National Press Building, Washington, D.C.

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1940

# BRICK

Annual Meeting of  
National Paving Brick  
Association  
Congress Hotel,  
Chicago,  
January 30-31, 1940

FOR NEW CONSTRUCTION OR RESURFACE WORK

### Future Traffic Requirements Must Be Met by Intelligent Planning

We have passed through the period of large mileages of new construction on the main roads of the nation, and through the period of rapidly growing road income. Motor Vehicle registration has reached reasonably stable figures in that annual changes are in relatively small percentages. There has been a material increase in the amounts demanded for maintenance, administration and debt requirements, with the consequent depletion of construction funds. The distribution of highway user income to the local units, and the diversion to other purposes have also depleted the funds available to the state highway departments, while large mileages have been added to their responsibility for construction and maintenance.

All of these trends sum up in one fact—that the future ability of the state and Federal highway departments to meet traffic requirements more adequately must come largely through painstaking and intelligent planning. This is the purpose of the state-wide highway planning surveys. There has been some irritation here and there within the states because of the insistence of the Public Roads Administration upon the highway planning surveys, and perhaps the feeling that too much information and too much detail have been required.

Generally the cooperation of the state highway departments has been splendid, and fullest acknowledgment is here extended to them. It is unfortunate that in the few cases where there is any reluctance to continue these surveys and studies on an adequate scale, the information is most seriously needed because of inadequacy of funds for the demands upon them.

### Principal Elements of Highway Planning Surveys

During the past two decades there has been a constant and remarkable improvement in every physical element of the highway program, and these advances have been attended by equally constant lowering of unit costs. The same progress has not attended the economic planning of the highway systems, and it is this lack that the highway planning surveys were designed to fill. Before these surveys were undertaken the relative decrease in funds available to the highway departments, the increase in the number and speed of motor vehicles, and adverse legislation, were full of disaster for the highway departments. It was and is the firm conviction of the Public Roads Administration that the only possible chance the highway officials of the states and the Federal Government have to combat the crippling trends is to present the budget requirements of the highway system so soundly supported by the facts from the surveys, that their recommendations will receive the support of the legislative bodies.

The principal elements of the survey are:

1. A perpetual inventory recording the extent and condition of the whole highway system, the life expectancy of all existing improvements, and their probable salvage value in future reconstruction.
2. Currently revised estimates based upon an elaborate system of sample counts of the volume and variation of traffic on all roads and a determination of the class, size, weight, origin, destination, and purpose of travel of all vehicles composing such traffic, and the character and weight of the loads carried by them.
3. The dynamics of traffic flow, with particular reference to the characteristic behavior of traffic of all volumes under various conditions of road capacity and design.
4. The status of ownership of all motor vehicles.
5. The relative usages of all classes of rural roads

and city streets by residents of cities and rural areas, respectively, and by residents of the respective governmental subdivisions, for the purpose of determining the spread of benefit afforded by highway improvements.

6. The kind and rates of all taxes directly or indirectly imposed for highway purposes by all divisions of government, the amount of revenue raised by all such taxes, the amounts, terms, interest rates, and status of all bond issues, the incidence of all highway taxation, and the purposes for which all revenues collected are expended, such as for construction, maintenance, administration, regulation, police protection, etc.

7. The assembly of all available information necessary as a basis for the estimation of trends of increase in motor vehicle registration and traffic, both in general and in relation to particular classes and sections of roads, for the purpose of estimating future changes in the amount and character of road usage.

These surveys are regarded as of such importance by the Federal administration that the Congress has provided for the use of the 1½ per cent fund for surveys and economic investigations without the requirement that it be met by state funds. It is hoped, however, that the states will continue to support the surveys with state funds until the data now available have been consolidated and the reports are ready for the next sessions of the state legislatures. This work should now be speeded up since certain elements are of the highest importance in the development of plans for the national defense. A year ago the executive committee authorized the president of the association to request the appointment by the Secretary of War of a committee representing that department to work with similar committees from the association and the Public Roads Administration for the purpose of bringing the standards of highway design and the planning of highway systems into adjustment with the needs of the national defense. These committees were appointed and much progress has been made in this field and a definite program of further cooperation is now being drafted. It is expected that a representative of the War Department will appear before the association during this meeting to outline the importance of adequate highways to the national defense and the increased reliance upon them because of the rapid development of motorized equipment of all kinds.

### Highways and National Defense

From time to time there has been much agitation for so-called military highways, usually conceived on a trans-continental basis by enthusiasts who had neither highway nor military background. The report presented to the Congress by the Bureau of Public Roads entitled "Toll Roads and Free Roads" which was made possible through the active cooperation of the state highway departments, discusses in detail based upon factual evidence, the weaknesses of our present road system. It outlines the character and extent of the corrections that are vitally necessary to serve existing and probable future traffic. It is soundly established that the national defense will be best served by a highway system that provides adequately for the traffic at all times, and special requirements are very limited. The report recommends a system of inter-regional highways which will connect the population centers of the country, with first attention to be given to the highways within and through the metropolitan districts. The report also recommends the modification of the existing Federal aid system by the replacement of inadequate bridges, correction of bad alignments and similar improvements. In addition to these types of improvement already recommended, the





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# SOIL-CEMENT ROADS

## The New Answer to the Light Traffic Road Problem

**E**XTENSIVE laboratory research has developed the basic principles of combining natural roadway soil and portland cement to produce a durable, weather-resisting material for low cost, light traffic roads.

This does not involve *cut and try methods* or *guesswork*. Scientific tests in the laboratory predetermine the amount of cement, moisture, and density required for a particular soil to *insure* durability under the wetting and drying, freezing and thawing conditions encountered in the field. Proper hydration of cement is an essential factor in attaining this end. Good engineering control on the job is, of course, essential as the laboratory findings must be applied in construction. . . . But although *scientific*, both laboratory and construction procedures are *simple*:

### OUTLINE OF METHODS

The existing soil or old roadway is scarified and pulverized to a depth of about 6 inches. . . . A carefully predetermined amount of portland cement is spread evenly over the soil and then mixed in with simple equipment such as field cultivators, gang plows, mechanical tillers and disc harrows. . . . The proper amount of water is added and then mixed (with the same equipment), the mixture compacted from the bottom with sheeps foot rollers to required density, struck off to crown and grade and ironed out with heavy smooth rollers. . . . The surface is then protected from rapid evaporation for a short period with damp straw, hay or earth.

Experience on 111 jobs throughout the country totaling 227 miles (completed to June 1, 1939), has demonstrated that this construction is practical, durable, low in cost and that simple, readily available equipment may be used.

Soil-cement roads should not be confused with portland cement concrete. They are not intended for the heavy-duty service where concrete is both superior and essential; but soil-cement does offer a durable and strong material in the low cost, light traffic field. It is good for secondary airport runways, too. Write us for the details.

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national defense needs would include a limited mileage to serve areas of mobilization as contemplated under the protective mobilization plan.

From this it will be evident that a highway program developed through cooperation between the state highway departments, the War Department and the Public Roads Administration to serve adequately the national defense, would follow in the main the recommendations already made to the Congress of the program now needed to serve existing and future traffic, and that the chief element of the program would be the establishment of priorities as to the order in which the improvements should be undertaken. The road program that is most important for the future, therefore, remains as a whole a single program, but intelligent planning is more necessary than ever before.

### Federal Assistance in Acquiring Right of Way

The chief obstacle to progress which has been discussed in detail in the report to the Congress is the difficulty in acquiring rights of way of adequate dimensions, and in the proper locations for the development of main traffic arteries, also for improvements such as grade crossing eliminations and correction of alignments on existing roads. This need is pressing, and it appears that prompt action can only be secured through Federal legislation. Senator Hayden and Congressman Cartwright introduced at the close of the last session of the Congress a proposed bill to make it possible for the Federal Government to assist the states in acquiring adequate rights of way and to help with the financing by extending the payment over a long period of time. In the whole detail of the road program most desirable for the future, nothing is more important than that legislation of this character shall become effective. Without some such authority it is impossible to accomplish promptly important undertakings whose construction costs are already financed in whole or in part. The difficulty of securing rights of way, even in small tracts, has held up many Federal aid road projects, and has been one of the most serious factors in delaying the grade crossing elimination program.

All of the elements and agencies of both state and Federal governments concerned with road improvement are being constantly brought into a more closely knit endeavor so that their combined efforts will be more effective. When legislation is before the Congress during the coming winter it is hoped that the major handicaps to progress, particularly the land difficulty, will be removed.

Every circumstance affecting highways and their utilization with which we are now faced, domestic or foreign, can be best met by complete and generous cooperation between the States and the Federal Government acting through their established highway departments, if the planning of the immediate and long-time programs for action receives the intelligent and continuous attention necessary from these agencies.

*Acknowledgment*—The foregoing is a paper presented Oct. 10 at the 25th annual meeting of the American Association of State Highway Officials.

**They Measure Them By the Acre**—Two hundred and ninety persons per acre visited Illinois state parklands during the first ten months of 1939. This computation, based on an attendance of 3,975,355 up to Nov. 1, indicates that 1939 will set an all-time record, bettering the 1938 figure by more than 1,000,000.

## 17,000 MILES OF HIGHWAY IMPROVED

More than 17,000 miles of highway were improved during the past fiscal year in the program administered by the Bureau of Public Roads of the U. S. Department of Agriculture, according to the annual report of that Bureau, which is now the Public Roads Administration of the Federal Works Agency. Accomplishments of the year included the elimination of 382 railroad-highway grade crossings, reconstruction of 86 obsolete grade-crossing structures, and protection of 438 crossings with signals and other devices.

Outstanding features of the program were the large amount of work done in widening, straightening, and otherwise modernizing important main highways, the excellent progress made in eliminating hazards at railroad grade crossings, and the completion of nearly 3,000 miles of secondary roads.

The major part of the work was done in cooperation with state highway departments, 13,482 miles being completed in this cooperative program. This work included 9,786 miles on rural portions of the Federal-aid system, 2,971 miles on the secondary or farm-to-market systems, and 725 miles in municipalities.

Classified according to types of construction, the cooperative work consisted of 1,392 miles of graded and drained road; 6,092 miles of treated and untreated sand-clay, gravel, and macadam; 2,568 miles of low-cost bituminous mix, 138 miles of bituminous macadam; 646 miles of bituminous concrete, 2517 miles of portland cement concrete; and 129 miles of bridges, grade separations, and miscellaneous types.

The Bureau also supervised road construction in National parks, National forests, reconstruction of flood damaged roads, and roads financed with funds allotted by the Public Works Administration and the Works Projects Administration. Work of this class aggregated 3,678 miles.

During the year the Bureau completed the first comprehensive study ever made of the national highway situation, taking into account conditions on city streets, main rural highways and on secondary or farm-to-market roads. The study revealed that express routes passing directly through the centers of our largest cities are urgently needed to relieve serious traffic congestion. Difficulties of acquisition and the high cost of necessary rights-of-way are the most serious obstacles hindering provision of the needed improvements.

The report, which was sent to Congress with a message from the President on April 27, 1939, recommended: The construction of a system of inter-regional highways complete with connections through and around cities; modernization of the Federal-aid highway system; elimination of hazards at railroad grade crossings; improvement of secondary roads, and the creation of a Federal Land Authority to facilitate the acquirement of lands needed for public purposes.

The report containing these recommendations was made in accordance with an act of Congress that directed the Bureau to investigate and report on the feasibility of constructing and operating on a toll basis three east-west and three north-south superhighways spanning the country. The Bureau's study showed that construction of such a system of toll roads would not be economically feasible, nor would it solve any considerable part of our highway problems.

Effective July 1, 1939, the Bureau of Public Roads was transferred from the Department of Agriculture to the newly created Federal Works Agency and its name changed to Public Roads Administration.



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Truck maintenance costs can be reduced by using this Safety Tripping One-Way Plow for main thoroughfares and fast plowing on highways.

Automatic safety tripping moldboard offers complete protection of equipment and safe operation at high speed. Variable angle adjustment makes provision for every requirement. Full

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*Harold E. Bayne*

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*The Ambassador*  
IN ATLANTIC CITY



# DEEPEST WISCONSIN ROAD CUT

**B**ETWEEN Hazel Green, Wisconsin, and U. S. Route 61, A. B. Lynch Co. of Milwaukee, is moving 400,000 cu. yds. of dirt and 100,000 cu. yds. of Galena limestone to build 9½ miles of road for the State of Wisconsin.

This realignment of Wisconsin Route No. 11 entails the construction of the deepest cut in the state. The new highway will complete a modern road from Dubuque, Iowa, through to Madison, Wisconsin. Its 9½ miles are practically straightaway over rolling country. It will be parallel to the Illinois-Wisconsin line, and is just within the Wisconsin boundary. Dirt moving began September 21, 1939, and is slightly ahead of schedule.

**Work Methods On the Cut.**—The deep cut, on the west end of the road, will reach to a depth of 90 ft. when completed. This phase of the project involves a one-to-



*Looking East Toward the Cut, With the Old Road in the Foreground. To the Right of the Old Road is 20 Ft. Gully Now Completely Filled by Rock and Clay Taken From the East End of the Cut. Portable Lighting Unit in Foreground Assists Night Work.*

one slope on the west side down which clay and blasted rock have to be hauled. There is a creek running at the bottom, and a glacial wash of heavy clay sloping down the east side of the ridge.

The tough rock of the cut is broken by blasting, the holes being rather closely spaced and ten feet deep. In preparing the hauling ramp, which has a 20 degree slope down the one-to-one base of the west side of the range, a LeTourneau angledozer performed almost all of the work. The 360 ft. ramp is 18 ft. wide and angles down from the top of the cut with two sharp turns.

A wide gully, 20 ft. deep alongside the old road and about 1,600 ft. from the foot of the ramp, has already been filled with rock and dirt from the top of the cut. On the shorter hauls, four Caterpillar D8 tractors with LeTourneau 12-yd. scrapers are taking the dirt from the east side of the ridge, through the unfinished cut, down the ramp, and spreading it at the foot of the west side of the ridge. These are alternating scraper loads of rock and dirt. Treated wood piling are being driven through this fill to support the footing of a bridge which will directly adjoin the cut—so close, in fact, that a concrete abutment for the structure will be set directly against the ledge of the ridge.

A total of 65,000 cu. yds. of solid rock and 20,000 cu. yds. of dirt will be removed to form the cut through



*Note the Comparatively Close Spacing of Powder Holes in the Limestone Ledge. Looking East From Top of 90 Ft. Cut.*

this highest ridge. Slopes will be one-tenth to one, or practically vertical.

To date, the work has progressed steadily and rapidly two seven-hour shifts a day, with the tractor-scraper units averaging 1,200 ft. hauls and requiring 14 minutes per round trip. Loads average 7 yds. for all-rock, and on dirt hauls, 9 yds. A D8 pusher tractor has been found particularly valuable in working the sticky clay on the east side of the ridge.

Working in rock, frequent structural repairs are necessary, but these are handled quickly and cheaply with a welding unit.

**Surfacing.**—The sub-grade for the new road will be



*Phil Kaiser, General Foreman, and A. F. Keyes, Superintendent for A. B. Lynch Co., Look Over Plans of the Job.*

# INCREASE YOUR YARDAGE WITH LESS EQUIPMENT!

## USE A PUSHER TRACTOR . . .

Boost payloads and profits on tractor-scraper work . . . yet save 25% on equipment. Four

pusher tractor-scraper outfits with a tractor will handle as much or more the power on the scraper cutting edge where you need power . . . loading. Load in a half to a third less time and in much shorter distances . . . heap 2 to 3 extra pay yards into every load . . . make smoother, even cuts. No gouging to get a load . . . less straining and jerking on tractor and scraper, less wear and tear on steering clutches, little or no job time lost for breakdowns . . . reduced maintenance costs. Less operator fatigue, too, because there's less pulling on steering levers, less gear shifting—you avoid that last-two-hours-of-the-shift letdown. Prove to yourself . . . on your own job . . . that an "L" pusher can boost your yardage as much as 50%. Ask your Allis-Chalmers dealer to demonstrate pusher loading and Faster Power.

### PUSHERS AND BUTANE . . . EXTRA YARDS AND LOWER COSTS

Hodkins and Perry increased scraper payloads 2 to 3 yards with pushers on their 250,000-yard job in Iowa. They burn butane in all 8 of their Model "L" tractors. With Allis-Chalmers you can select tractors to use whatever fuel is best in your locality . . . gasoline, Diesel oil or butane . . . get a full, even flow of power from any one of the three.



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Years from now the traffic flowing over many sections of Pennsylvania's \$61,000,000.00 Turnpike will benefit from the foresight of the men who are installing *Pittsburgh Reinforcing* on the job. It's *bound* to be a better road! Literally, a concrete road in which this cold-drawn, high-tensile, welded steel mesh is embedded, is *bound* into integrated slabs that last longer, stand greater abuse and cost less to maintain. Write for full information.

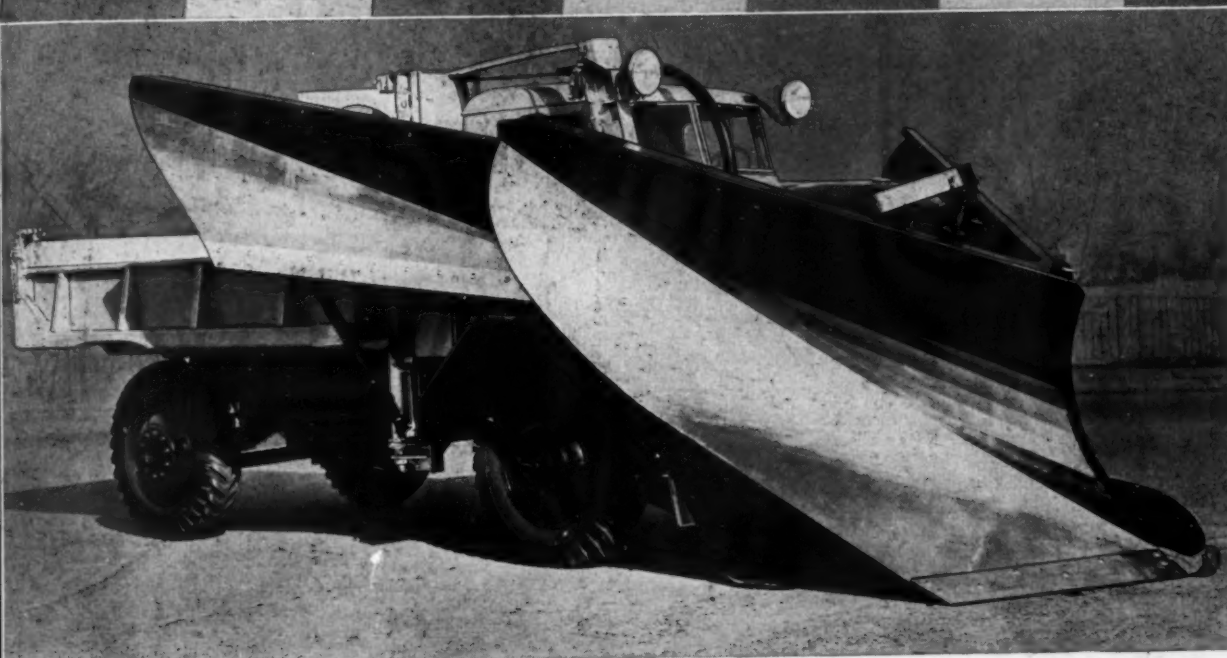


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# MISTER, IT'S YOUR MOVE FOR OPEN ROADS THIS WINTER



Yes sir, it's your move if you want to be sure that the traffic will keep moving over your roads this winter, instead of being tied in a knot by snowdrifts.

**WALTER SNOW FIGHTERS** plow through the heaviest drifts with a driving, smashing force that is amazing to those who are familiar with rear-wheel and ordinary four-wheel drives only. **Walter Four-Point Positive Drive** provides such extraordinary traction and great available power as to have the complete confi-

dence of road officials, bus companies and others in the "snow belt" where the problem of keeping roads cleared in mid-winter is a tremendously difficult one.

Ask us about Walter Automatic Lock Differentials . . . Suspended Double Reduction Drive . . . Ten-to-One Range Transmission . . . Exceptionally Powerful Heavy Duty Braking System, and other distinctive features that put Walter Snow Fighters in a class by themselves.

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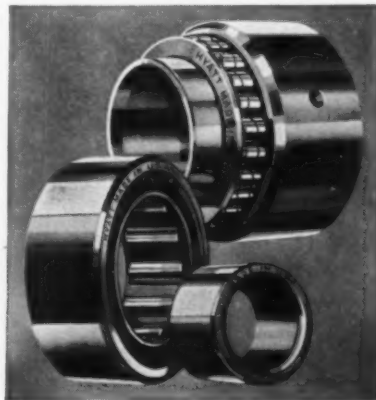


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HYATT ROLLER BEARINGS rotate so smoothly, so accurately, so efficiently that they are called upon to play an essential role in the smooth functioning of all mechanical equipment. Design engineers know from experience that Hyatts on gears, shafts and wheels bring a lifetime of dependable performance to their products. Thus to

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# HYATT

# ROLLER BEARINGS

scarified, sprinkled and rolled with sheepfoot tamping rollers to a specified density. After the first two courses, the subgrade and mine tailings, are shaped and rolled, the third or surface course will be rolled and treated with 125 tons of calcium chloride. The crushed rock for the surface to the amount of 41,000 cu. yds. will be taken entirely from the one deep cut. Just beneath this road surface mine tailings will be spread to prevent frost boils. Mr. A. F. Keyes, general superintendent, states that this is the first time this method has been adopted in the state.

The Lynch Company has the contract for all road construction, cut and fill work, and crushed rock surfacing on the 9½ mile route. The structural contract, including four bridges (two having piling abutments with concrete-steel superstructures, the third having a 25 ft. span all concrete, and the fourth a twin 10 ft. by 10 ft. concrete box) is held by Luetz Brothers of Beloit, Wisconsin.

### MOTOR VEHICLE OPERATING COSTS

Automobile operating costs are approximately 20 per cent lower on pavement than on gravel, and 26 per cent lower on pavement than on earth, R. A. Moyer and Robley Winfrey, of the Iowa Engineering Experiment Station, Ames, Ia., revealed in a recent survey. Average operating costs, including fixed charges, for rural-mail-delivery cars driven 15,000 miles annually, were found to be 3.34 cts. per mile on pavement.

This study, which classes concrete and bituminous surfaces as pavement, was based on complete year-round operating cost records of 293 automobiles driven by rural mail carriers in Iowa and Indiana. The analysis is reported in Bulletin 143, "Cost of Operating Rural-Mail-Carrier Motor Vehicles on Pavement, Gravel, and Earth," which may be obtained from the Station without charge.

The investigators conclude that a traffic volume of 63 vehicles per day will justify the graveling of an earth road, based on a determined saving of 0.35 ct. per mile in automobile operating cost and an interest charge of 4 per cent. If the road investment is to be amortized in 10 years, a traffic volume of 128 vehicles per day would be required.

The survey also indicates that operating costs are 0.5 ct. per mile greater during winter than during fall, justifying an annual expenditure for snow and ice removal of \$500 per mile of road per 1,000 vehicles per day in the northern states.

### 1939 COMPILATION OF ASTM STANDARDS ON CEMENT

All of the specifications and test methods issued by the American Society for Testing Materials covering cement are included in this 1939 publication. Each item is given in its latest approved form. Certain changes made in the specifications and tests as a result of recommendations of Committee C-1 on Cement are embodied.

Five specifications cover portland, high-early-strength portland, natural, and masonry cements, and sieves for testing purposes. Other standards cover the chemical analysis of portland cement, sampling and physical testing, including a Manual of Cement Testing and Selected References on Portland Cement. Other tests cover compressive strength of portland cement mortars and a fineness of cement by means of the turbidimeter. The

standard methods of chemical analysis (C 114-39) are included having been formed by removing certain sections from the methods of sampling and physical testing (C 77). To these will be added, when they are adopted the tentative methods of chemical analysis, which carry the designation C-114-39 T.

Copies of this 100-page book can be obtained from A. S. T. M. Headquarters, 260 S. Broad St., Philadelphia, at \$1.00 per copy in heavy paper cover.

### ASSOCIATION OF STATE HIGHWAY OFFICIALS TO MEET AT ATLANTIC CITY, N. J.

Atlantic City, N. J., has been selected as the meeting place for the 16th annual convention of the Association of Highway Officials of North Atlantic States. The convention will be held Feb. 14, 15 and 16 at the Hotel Ambassador where the same arrangements as heretofore will be in effect as regards the meeting room and space for exhibits.

President Logan has appointed the following as a Program Committee for the coming convention: George H. Henderson, Rhode Island, Chairman; H. O. Schermerhorn, New York, and Thomas C. Frame, Pennsylvania. This committee is engaged in the preparation of a program of papers and discussions in keeping with the popular subjects of the times. There will also be reports by standing committees on the results obtained thus far.

A. Lee Grover, Secretary New Jersey State Highway Department, Trenton, N. J., is secretary-treasurer of the association.

### HIGHWAY WORK GOT 66c OF TAX DOLLAR IN 1938

Only 66c of the highway user's state tax dollar—a tax dollar that in 1938 contributed \$1,175,202,000 to the states—was spent for actual construction and maintenance work on state highways and local roads and streets, according to recent reports of the U. S. Public Roads Administration. The remaining 34c was distributed: 15c for highway debt service; 4c for collection and administration of the tax; 2c for state highway police; and 13c for non-highway purposes.

The highest record of pay-as-you-go budgeting, with no diversion of highway funds to other purposes and no debt service expenses, was set by Idaho, which spent 96c of its highway-user tax dollar directly for the highways. Tax collection costs and state highway police divided the other 4 per cent. Other states which spent more than 90 per cent of receipts for highway maintenance and new construction, with no diversion, were Arizona, Nevada, Oklahoma, and Virginia.

Five states—Arkansas, Florida, Louisiana, Missouri, and Rhode Island—each spent less than 40c of the highway users' tax dollar for current road expenses. Arkansas and Missouri had no diversion of highway funds but their abnormally high debt service commitments took, respectively, 63c and 54c of every highway-user-tax dollar disbursed in these two states in 1938.

Florida and Louisiana combine high debt service charges with high diversion; in Louisiana, charges of 49c for debt service and 33c for diversion leave only 15c for current road work, 3c for collection and state highway police expenses. Rhode Island had only a 4c-per-dollar debt service, but the 57c of every highway-user-tax dollar that was used for non-highway purposes left little for the highways.



# EDITORIAL

## THE FAITHFUL REMAIN

ANOTHER session of the Highway Research Board is history. In true character many papers of highly technical character were presented from which practical design and construction ideas will develop. If complete understanding of only *one* sound natural law results the sessions would be well worth while. These meetings have the same shortcomings as all highway meetings the writer has ever attended that last more than one or two days. The last day the "faithful" remain while the majority have gone.

It is a problem of what to do to keep the sessions well attended. We generally know what subjects are most interesting. While common sense dictates that papers relevant to these subjects be grouped, perhaps it would be best to scatter the live subjects throughout the whole period of the convention and keep the best till the last day. In this way the crowd can be held intact even though at the expense of sensible continuity.



## THINKING ON HIGHWAY COSTS

DEFINITELY, there are two schools of thought amongst highway engineers regarding the evaluation of "annual highway cost." One group includes "interest" on the "investment" as an annual cost item. The other group omits this charge as well as the "taxes" item. These two schools were clearly exemplified by the papers and discussions presented during the recent Highway Research Board meeting.

The first group adheres to the formula presented to the Highway Research Board by the Committee on Transportation Costs, of which Prof. (now Dean) T. R. Agg was chairman. This formula containing an item of "interest" on the "investment" was submitted as a comprehensive method of computing the "annual cost of a highway." The second group has no particular quarrel with the formula when borrowed funds are used for construction, or for expenditure of borrowed capital; nor when, if taxes are used for construction, maintenance, reconstruction, and betterments, the "interest" factor is taken as *zero*.

The paper presented by Mr. Robley Winfrey contains the term, *rA*, which is the interest on the investment, or as he prefers to call it, the "investment return." By various comparisons he endeavors to demonstrate that the "interest" item is a logical charge against annual highway cost *whether it is actually paid or not*.

As a general formula for use wherever the capitalistic theory of enterprise has application, there is no objection to it. But our road systems, like our public schools, are not private enterprises nor are they operated for a profit that is to be returned in cash to those who furnish the funds. Roads are built for public convenience. No motor vehicle owner expects, nor is he ever given, a return in cash for the funds exacted from him as taxes for needed highway capital. To include "interest," therefore, is to include an imaginary item of cost. If imaginary cost items are to be included, there is a large number of such items that might be listed; why stop at interest? Since we are dealing with actualities rather than imaginative conditions, let us confine our bookkeeping to recording only what actually occurs.

In the capitalistic frame of thinking, funds are voluntarily contributed. The contributor or purchaser of stock, if you please, becomes a part owner of the enter-

prise. The owners appoint a board of directors who manage the enterprise. The managers then operate the enterprise and if successfully done, the business earns a profit on the investment after all ordinary and regular costs of operation are deducted. This profit represents the return on the investment freely contributed by the purchaser of the stock. It is converted into an interest ratio and returned in cash to the stock owners; truly an investment return.

In contradistinction with this frame of thinking we find the conception of the publicly or government owned facility in which none of these precepts are visible. The publicly owned highway is a facility created by the *power of government*. The collection of capital is an *enforced* procedure through the government a *power of taxation*. Both the manner and the amount of that contribution is defined by an act of government, be it federal, state, county, municipal, town, or benefit district. The legislators or city fathers establish the amount to be exacted upon some measure or assumption of ability to pay, prorated upon presumably as equitable a basis as they are able to determine. For road work the measure is based upon benefit to be derived or convenience to be enjoyed and the plan is imposed by consent of the governed. No matter what the measure or the method may be, citizens subject to it *must* contribute in the amounts prescribed, and they *must* do it without any thought or hope of financial gain. In other words, those persons subject to the imposed tribute do not acquire a profit making, or interest-returning, share in the ownership of the road system. Ownership is legally vested in the government.

Since the taxpayer envisages no hope of "interest" return upon the tax moneys he contributes, neither does he entertain the idea that government may use those funds for purposes of earning an interest return to government. On the contrary, it is generally to avoid the payment of a profit to private enterprise that he consents to allow his tribute to be used for expenditure in a publicly owned facility.

There are instances of publicly owned "public utilities" in which government has received an investment return or profit, but it is questionable whether, in either general or in specific cases, this is a desirable public policy.

In conclusion, we may conceive the State, for comparative purposes, as being one of two things. First, we may regard it as a governing power. Second, we may regard it as a corporate body politic through which the highway system is owned by taxpaying investors. If we adopt the first arrangement it is inconsistent with that viewpoint, for a government to collect from its citizens an "investment return" on the expenditures made to create its highway system. If we adopt the second arrangement, we must concede that the highway system is owned in common by the taxpaying "investors." In this case, then, the so-called "investment return" is due to those taxpaying "investors" and not to the State, and since, for the most part, the contributors of the capital are the ones who use the roads (both in direct proportion) the most practical way of paying an "investment return" to them as the "money lenders" is not to collect it from them as road users. Either way it is viewed, the item of "fair return" or "interest on the investment," so far as highways are concerned, their creation and the way they are used, there seems to be no practical reason for including it as a factor in the "annual cost of a highway" or as a payment on a highway.



Closing In



Stock Pile Covers

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THE two snow pictures show how adaptable Sisalkraft is — what complete, weathertight protection it provides. The top picture shows a 20' x 20' blanket covering a sand pile as widely used by Maintenance Departments to skidproof icy pavements. It weighs 31 lbs. and costs approximately \$4.41. Made of Orange Label Sisalkraft specially treated to resist shrinkage, scuffing and soil rot — Sisalkraft Blankets are the economical answer to effective winter protection.

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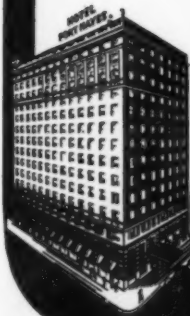
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## NEW EQUIPMENT AND MATERIALS

### New Tamping Rollers and Rippers

Rippers and tamping rollers have recently been placed on the market by Bucyrus-Erie Co., South Milwaukee, Wis. The new Bucyrus-Erie tamping rollers are offered in single, double, or triple drum models, with 72, 96, or 112 ft. per drum available in each model. All rollers have rear pull connections for working in trains, and all drums are provided with openings for ballast. Double and triple drum models have oscillating drums which permit the rollers to adapt themselves to uneven ground surfaces. The tamping feet are renewable; when they become worn, they are not replaced or refaced by welding. Instead, they are easily removed and easily replaced with new feet. The new rippers are of two types, the rotary type and the heavy duty cable-operated type. Outstanding feature of the rotary type ripper is a rotating head, which swings the ripping standards up and back and



*New Tamping Rollers and Rippers*

around to ripping position again quickly. This quick raising and lowering of standards is stated to make the rotary ripper especially effective for work in material containing boulders and heavy roots. Complete rotation of the head also dislodges rocks and debris caught between the standards and prevents the ripper from picking up the same debris again. Since power to rotate the head is derived solely from the pull of the tractor drawbar, the rotary ripper can be used with tractors having hydraulic controls or with tractors having no auxiliary power equipment. The cable-operated ripper is a heavy duty ripping tool for breaking up exceptionally hard-digging, hard-loading materials such as shale, hardpan, decomposed granite, sandstone, old macadam, etc. Controlled by a cable operated from the tractor winch, it is stated the standards on this ripper can penetrate full length below ground level, 17 in. on Model CR-1 and 24 in. on Model

CR-2. The standards can also be set at any intermediate point or raised above ground for traveling. To add to the life of the ripper, the self-sharpening ripping points are renewable and can be easily replaced as they become worn. Many other features of these new rippers and tamping rollers are described in bulletins published by the manufacturer. These bulletins can be obtained by writing to this magazine or to Bucyrus-Erie Co., South Milwaukee, Wis.

### New Combination Shovel and Dragline

A new combination shovel and dragline, the Lima Type 1201, has been placed on the market by the Lima Locomotive Works, Inc., Lima, O. When equipped as a standard shovel, it carries a 30 ft. boom, 20 ft. dipper handle and a 3 yd. bucket. For special work such as open-pit mines, the machine can be equipped with a 42 ft. boom, 32 ft. dipper handle and a 2½ yd. dipper. The Type 1201 incorporates many modern features; for instance, the shovel boom and dipped handle are box type design, electrically welded throughout. Only three levers and two foot pedals are necessary to control the three major operations, hoist, swing and crowd. The Type 1201 is equipped with inside expanding clutches with housings cooled through radiation fins. The clutches and brakes have extra large diameter. Roller bearings are applied to the hoist brake and clutch housings to effect smooth, velvety clutch action. The hoist clutches are equipped with vacuum power assistors operating through toggles, which makes possible the lowering of load with the clutch engaged. This feature is especially adapted to crane work. Each major operation is independent of the other which makes it possible to hoist, travel, swing and raise or lower the boom simultaneously. The drums have extra large diameters. The cast steel drum laggings are split and are easily changed to fit exactly the right line speed for any job. Helical cut gears are used throughout. To further the efficiency of the Type 1201, roller bearings are used at every vital bearing point. The crawler truck is composed of a one-piece base casting with seven axles on the ends of which revolve 14 open type, self-cleaning rollers. It is 18 ft. 11 in. long and 13 ft. 1 in. wide and is of the end drive principle with drive chain located back under the



*Lima Type 1201 Combination Shovel and Dragline*

crawler treads. Steering is accomplished with the upper frame at any position, which is an advantage when propelling in close quarters. More than one-half of the cab can be opened to give ample ventilation in hot weather. The Type 1201 can easily and quickly be converted in the field for dragline or crane service and can be furnished with either diesel, oil or electric power.

### New Road Finishing Machine

A new road finishing machine stated to introduce a number of improvements and distinctive features has been developed by the Blaw-Knox Co., Farmers Bank Bldg., Pittsburgh, Pa. The finisher is a gasoline-driven machine of the double screed type. Highlighting the new features is a unit transmission which accommodates all functions of the machine, both as to traction and screed drives. A 4-cylinder, 24 h.p. gasoline engine provides the power and drives through the compact and fully automotive transmission. The speed of screed stroke is synchronized with the finisher's speed of forward travel—the faster the machine travels forward, the faster the



*Blaw-Knox Finisher at Work on the Pennsylvania Turnpike Near Somerset, Pennsylvania.*

screeds stroke. This feature of design prevents tearing of the surface as the machine moves ahead. With the objective of further increasing the thoroughness of mechanical finishing, provision has been made for screed operation while the machine is not traveling. Thus the new finisher can stand still with the screeds stroking until sufficient mortar has been drawn to the top of a dry concrete mix, thereby eliminating bare and torn spots on the surface of the pavement. The screed designs are such that structural extensions can be added in the field. Facility for change in width of the machine is likewise provided. This is accomplished by bolting the transverse frame members of the machine to the end trucks at the desired point within a range of 2 ft. Should holes also permit changes in fractional inches. All controls are conveniently located and easily handled with the result that the operator runs the machine much like driving an automobile. The traction wheel mountings are on the outside to facilitate wheel changes. As a final note of convenience, the finisher can be transported by a moving truck with two

wheel assemblies which are easily attached without the necessity for getting underneath the finisher.

### Enclosed Cab Now Available for Austin-Western Patrol Sweepers

The patrol sweeper, manufactured by the Austin-Western Road Machinery Co., of Aurora, Ill., can now be equipped with a streamlined, enclosed cab. This cab was developed for the operator's comfort and protection since a good deal of sweeping is done at night and during cooler weather. According to the manufacturer, the oper-



*Patrol Sweeper Equipped With Cab*

tor's visibility will not be impaired because the visibility from within the cab is better than that from within an ordinary automobile. Further, the cab is very roomy and comfortable. Two doors make it possible for the operator to enter from either side, and the upper windows in the doors can be raised and lowered at will.

### New Truck Mixers and Agitators

Three, 4 and 5 cu. yd. sizes have been added to its line of Smith-Mobile truck mixers and agitators by the T. L. Smith Co., Milwaukee, Wis. The Smith-Mobile is equipped with a large feed chute located at the high end of the drum. Since the drum revolves during the charging operation, shrinking and mixing begin as soon as the materials enter the drum. Water is introduced through the drum charging opening. A high pressure, turbine-type water pump is regularly supplied as standard equipment. The Smith-Mobile has an unusually high discharge which permits a larger radius of spout distribution. The discharge door can be opened wide to permit inspection of the batch while the drum is revolving. For discharging the batch, the operator merely reverses the direction of the drum. It is claimed that the speed of discharge is not controlled by opening and closing the discharge door. Even when the door is wide open, the operator can obtain either slow or fast discharge, as desired, by operating the clutch lever. Dual control levers are banked for operation from either platform or ground. Other Smith-Mobile features include: Welded Man-ten steel

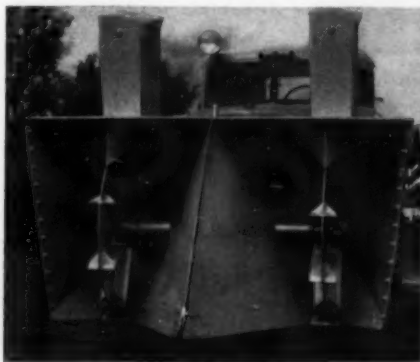


*New Smith-Mobile Truck Mixer*

mixer drum and frame . . . Machine cut, heat-treated alloy steel gears . . . Heat-treated, ground steel shafts on roller bearings . . . Welded, annealed steel transmission case and drum support pedestal . . . Oil type disc clutches . . . Two-compartment, overflow type water tank with calibrated gauges and lubricated plug type valves . . . Two-piece, swivel distributing chute . . . Choice of separate gas engine drive or power take-off for truck engine drive. A new Smith-Mobile catalog No. 198 is just off the press. Copies are obtainable from the manufacturer.

### New Rotary Snow Plow

A new rotary snow plow has been announced by the Wm. Bros. Boiler & Mfg. Co., Minneapolis, Minn. The mouldboard of the plow is formed in the shape of a letter "W" with a double rotor placed in each half of the "W". As the plow is moved forward into a snowbank, the snow is broken by the side and center edges and moves inward along the slant of each of the four sides of the "W". The snow feeds into the hollow formed by the blades on each side of the rotors. Thus the snow has but a very short distance to travel to reach the side of each rotor where it is broken up and thrown far with one motion. Provision is made to throw all of the snow to either side of the road without interfering with the driver's vision. Where a loading plow is desired to load trucks, the same plow can be used with a detachable loading chute which takes the snow from both rotors. The driving mechanism is carried on sealed anti-friction bearings bathed in oil. The rotors are full floating on taper roller bearing and are connected to the transmission through readily replaceable shear pins. The rotaries are made in sizes to fit trucks, tractors or motor patrols



*Sno-Fly Rotary Plow*

# UNION METAL TOP and BOTTOM!

Union Metal makes a double contribution to Cleveland's new Main Avenue Bridge! Down under, supporting eight of this mammoth structure's main piers, are 1100 Tapered Monotube Piles. On top, lining both sides of the highway, are scores of Union Metal steel standards on which are mounted the newest of sodium lighting units.

Use of Tapered Monotubes for steel-encased concrete piles makes for lower installation costs and provides a substructure possessing greater load-supporting values. Union Metal lighting standards combine correct mounting height with modern design and long-life steel construction.

If your problem is one of supplying better light or supporting bigger loads, specify "Union Metal."

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and can be furnished with a separate motor to operate the rotors or optionally, in many cases, with drive from the motor of the operating vehicle.

### New Type Reflector Signs

New York City's new super-highway, the Henry Hudson Parkway, extending along the Hudson River for about 11 miles, has been equipped throughout its entire length with directional signs and traffic control signals made with a recently developed reflector material. The new material, Mir-O-Ray, which has been approved by Robert Moses, Commissioner of Parks, City of New York, for general use on projects under his jurisdiction, is manufactured from sheets of specially processed aluminum by the Mir-O-Ray Division of the Arcturus Radio Tube Co., Newark, N. J. The manufacturing process



Mir-O-Ray Sign on Henry Hudson Parkway.

ess consists of pressing highly reflective rust-resistant sheets into a panoramic mirror surface—countless indentations and projections which act as tiny mirrors set at thousands of different angles. Because of the varied angles at which light is reflected, it is stated the material does not return light rays to their source, but distributes light equally, thus eliminating glare and distortion of the sign letters. Mir-O-Ray is available in sheets up to 18x36 in., or in strips, letters, numbers and characters, making it convenient and economical to use. Complete details regarding installation methods and samples of the material may be obtained on request to the manufacturer.

### New 13¼-Yd. Excavator

A new 13¼-yd. excavator, the Lorain-80, has been brought out by the Thew Shovel Co., Lorain, O. This machine is available with a complete line of interchangeable boom equipment, as a shovel, dragline, crane, clamshell and backdigger. The turntable of the Lorain-80 is built to the Thew center drive design and follows very closely the proved design and construction principles of all Lorain machines. Its outstanding features are claimed to be a simplicity of construction and the ability to concentrate power entirely on one operation, or to spread it over two or three simultaneous and syn-



The New Lorain-80

chronized operations. The unit may be powered by a 6-cylinder Waukesha-Hesselman oil engine, a full Diesel, a 6-cylinder gasoline or an electric motor of any standard commercial type to suit specifications. The crawler base is a center "chain" drive crawler, 14 ft. 1 in. in length and 10 ft. 10 in. wide. It is equipped with 28-in. treads; 34 in. treads may be installed if desired. The crawler has two travel speeds—high, 1½ M.P.H.—low, ¾ M.P.H. The unit may be steered in either direction at either speed, giving it the maximum maneuverability. The effective length of the shovel boom is 24 ft. 8 in. It is equipped with an 18 ft. dipper stick. The shipper shaft is located at the center of the boom. The shovel boom is an all-welded, all-steel design. The dipper stick is an all-steel, all-welded structure of rectangular cross-section and is equipped with a spring mounted greenhorn cap to eliminate impact shocks. Two long-range stripping shovel booms are available for the Lorain-80: one consists of a 25-ft. boom, 25-ft. stick, 1½-yd. dipper; the other has a 30-ft. 6-in. boom, 25-ft. stick and 1¼-yd. dipper.

### New Engine-Driven Welder

A new 200-ampere engine-driven arc welder has been announced by The Lincoln Electric Co., 12818 Coit Road, Cleveland, O. The new welder, designated the "SAE-200 J" is of the Junior type. It is light enough to be wheeled readily by one man, or lifted easily on its single balancing hook by average moderate-capacity chain or crane falls. The weight is under 900 lb. Dimensions, stationary model, are: length, over radiator grille 56 in., over hand crank



Welder with Covers Open

63¾ in., width 20¼ in., height 37¼ in. The portable model (shop type) is same length as stationary type and 27½ in. wide (wheel clearance) by 44½ in. high. The "Lincoln Junior" is available as a portable unit with steel-wheeled running gear, shop type and as a stationary unit, either for fixed mounting in the shop or for installation on a truck or trailer.

### New Gravel Plant

Another Duplex crushing plant has been added to the line of Pioneer Engineering Works, Inc., 1515 Central Ave., Minneapolis, Minn. This is a smaller plant designed for smaller jobs. Heretofore, Duplex crushing plants have been used mostly by the producers requiring large capacity. The new Pioneer 16-V crushing, screening and loading plant uses a 916 jaw crusher and a 16-in. by 16-in. roll



New Pioneer 16-V Crushing, Screening and Loading Plant.

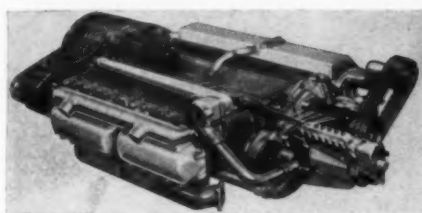
crusher. The jaw crusher takes the large rocks and the roll crusher does the secondary and fine crushing. One of the outstanding features of the 16-V plant is the "bottom deck feed," which has proved so successful on the larger sizes of Pioneer Duplex plants. The bottom deck feed doubles the effective screen area and balances the work of the two crushers. It screens the pit material on the bottom deck and the crushed material on the top deck. For full details on the new Pioneer 16-V Duplex crushing, screening and loading plant, write to the Pioneer Engineering Works, Inc., Minneapolis, Minn.

### New Heavy Duty Engine

Hercules Motors Corporation of Canton, O., has added the DFX Series to its line of high-speed, heavy-duty engines. These engines are of horizontal or "pancake" design and were developed primarily for applications wherein limited space requires engines of minimum height. While differing in general design from the well known Hercules vertical engines, these heavy-duty models are of relatively light weight. The internal dimensions of the DFX Series of six-cylinder Hercules Diesels are as follows:

Model	Bore	Stroke	Displacement
DFXB ....	5 in.	6 in.	707 cu. in.
DFXC ....	5¼ in.	6 in.	779 cu. in.
DFXD ....	5½ in.	6 in.	855 cu. in.

Model DFXB develops 176 H.P. at 1,800 R.P.M. and has a maximum torque of 530 at 1,300 R.P.M. Model DFXC develops 191 H.P. at 1,800 R.P.M. and has a maximum torque of 535 at 1,300 R.P.M. Model DFXD develops 193 H.P. at 1,600 R.P.M.



New Diesel Engine

and has a maximum torque of 645 at 1,300 R.P.M. In designing the engine special care was taken to assure proper lubrication. The oil capacity of the DFX is exceptionally large, due to the use of an oil tank built directly into the oil pan. A water pump of abundant delivery assures proper cooling of oil in the engine parts and a carefully planned water circulating system eliminates any tendency toward hot spots. The fuel pump is built integral with a suitable governor and is driven either from the front of the camshaft or mounted at the top of the cylinder block and driven by chain. The cylinders of the new engines are of cast iron with removable dry type sleeves made from special alloy. The crankcase is of cast iron and is cast integral with the cylinder block. The engines have overhead valves with silchrome exhaust valves. Pistons are heat-treated aluminum alloy and piston pins are of the full floating type. The 7-bearing crankshaft is made of special steel with surface-hardened bearings.

#### New Shovel

A newly-designed line of crawler shovels, 1½ to 2 cu. yd. capacity, Series "300," equipped with Speed-o-Matic hydraulic (oil) power control and Diesel, gasoline, oil or electric motor drive, has been announced by Link-Belt Speeder Corporation, Chicago. Among the salient features enumerated by the manufacturer, are these: New design throughout, giving greater strength, life, stability and efficiency, without the burden of extravagant weight. Greater speed and ease of operation, with the improved Speed-o-Matic control. Safe, fool-proof control of travel, steering and locking brakes entirely from operator's position in cab; incorporating an automatic locking arrangement against involuntary movement of machine when it is out of travel gear. Increased ground clearance, 14½ in. to 18 in. clear, with travel, steering and locking machinery entirely enclosed; and with no protruding housings and parts to ob-



New Link-Belt Speeder Shovel.

struct travel or become damaged or fouled. Choice of crawler widths and lengths to suit any practical operating or ground condition. Extreme simplicity throughout, without sacrifice in versatility, including stress-relieved, unit-construction main frames of unusual depth and strength; large, rugged machinery with machine cut gears throughout, anti-friction bearings, and other money-saving features. Ease of conversion to shovel, drag-line, crane, or other front-end equipment. Particular attention is called to the fact that the new line is being announced only after over a year of field tests as a shovel, drag line and crane on tough digging and handling jobs. De-

tails of construction, working ranges, clearance dimensions, and safe loads at the various radii, are given in a new 12-page illustrated catalog which will be sent to any reader upon request addressed to Link-Belt Speeder Corporation, 301 W. Pershing Road, Chicago.

#### 19 Chassis for Special Bodies in Ford V-8 Line

Nineteen chassis types are included in the 1940 line of Ford V-8 trucks and commercial cars. They range in wheelbase from 101 in. to 194 in. and comprise the largest selection for special body in-

## WHEN OLD MAN WINTER SAYS "No"



## MARMON-HERRINGTON

### All-Wheel-Drives SAY "GO!"

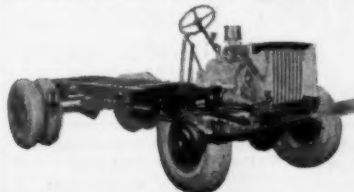
Whether it's hot, whether it's cold, whether roads and fields, forests and hills are knee deep in mud or snow,—there are always some jobs that must go on!

Oil field equipment, supplies and men must be transported to and from drilling locations. Logging "shows" can't close down when blizzards howl, or when winter rains and thaws make quagmire of roads and forest trails. Ice and snow must be cleared from the nation's highways. Overland freight and passenger service must be maintained with safety on slippery highway curves and hills.

These are just a few of the many winter hauling jobs for which Marmon-Herrington All-Wheel-Drives are literally "made to order." Jobs that only power and traction on all wheels can lick with any degree of dependability and speed. Jobs that no other automo-

tive vehicles can handle with the same sureness, safety and economy.

For hauling tremendously heavy loads over the most difficult terrain there is a complete line of mammoth four- or six-wheel-drive trucks and truck-tractors with load capacities up to 25 tons for trucks, or 50 tons, or more for tractors. For lesser loads, but just as difficult "going," we convert all standard Ford trucks, commercial and passenger cars to All-Wheel-Drive. There is nothing like them in low price, economical operation and amazing ability to perform on steep hills, in deep mud, sand or snow. Catalogs describing 1940 models will be mailed promptly on request. Cableaddress MARTON, Indianapolis, Indiana, U.S.A.



**MARMON-HERRINGTON COMPANY, INC.**  
INDIANAPOLIS, INDIANA, U.S.A.



stallations ever offered in the history of the company. All truck chassis provide standard cab-to-axle measurements and frame widths for mounting standardized bodies built by independent body manufacturers. New in the line are the regular and cab-over-engine chassis of 158-in. wheelbases. The former provides a cab-to-axle dimension of 84 in. and the latter a cab-to-axle dimension of 117 in. Three chassis types—chassis with cowl, chassis with windshield and chassis with cab—are available in each of the following: 134-in. and 158-in. regular wheelbases, 122-in. 1-ton and 122-in.  $\frac{3}{4}$ -ton wheelbase and the 112-in. commercial car chassis. A chassis with cab type is available in the 101-in., 134-in. and 158-in. cab-over-engine wheelbases and

a chassis-with-cowl type in the 194-in. wheelbase. The 112-in. and 122-in. wheelbase chassis are available with either the 85 or 60 hp. engine and the larger trucks with either the 95 or 85 hp. engines.

#### New Emergency Electrical Flare

A new patented emergency electric light which has been perfected by Triumph Explosives, Inc., of Elkton, Md., is claimed to contain all the qualities of the old dry cell, with the important advantage that absolutely no deterioration can take place before the light is required for use. The new battery is similar to the standard type of lantern battery both in appearance, method of contact and voltage capacity. The main difference is that the cells are



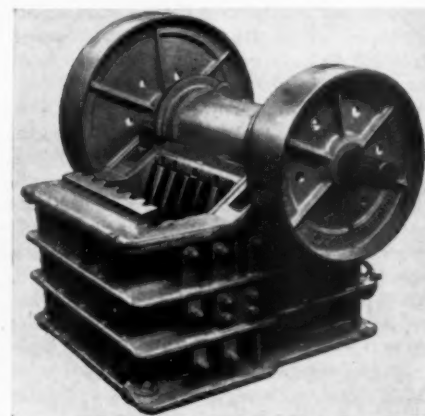
New ABY Utility Compressor

59½ in. Specifications include the following:

Compressor—	
Bore—Low Pressure Cylinder...	.6¼ (1)
High Pressure Cylinder...	.4 (1)
Stroke .....	.4½
R.P.M. ....	1250
Actual Capacity, CFM.....	.85
Working Pressure .....	100 lb.
Engine—	
Make .....	Hercules
Model .....	QXC-5 6 cyl.
Bore and Stroke .....	3¾ x 4¼
R.P.M. ....	1250
Magneto .....	Bendix
Carburetor .....	Zenith
General—	
Make of Clutch .....	Twin Disc
Radiator .....	Sectional
Frame .....	All Steel
Size Air Receiver .....	14 in. x 40 in.
Capacity Fuel Tank .....	12 gal.

#### A New Primary Jaw Crusher With Anti-Slab Jaws

The new Pioneer 2036 jaw crusher of the Pioneer Engineering Works, 1515 Central Ave., Minneapolis, Minn., can be furnished with new style jaw plates that are



New Pioneer Jaw Crusher.



Emergency Truck Flare

packed and sealed in a dry state and activated only by striking the bottom of the battery against any solid object. It is stated no deterioration can take place because, until the battery is struck, the cells do not become energized. This unit in specific form has been approved by Underwriters' Laboratories, Electrical Testing Laboratories of New York and various state commissions throughout the United States. This type of cell is also made in standard battery form to fit any electric device using dry cell batteries.

#### New 85 Cu. Ft. Portable Compressor

A new compressor designed expressly for work requiring quick transport to the job and easy handling at the job has been added to the line of the Gardner-Denver Co., Quincy, Ill. The compressor is mounted on a roller bearing 2-wheel spring trailer for high speed to or from the job. On skids, this compressor is compact enough for mounting crosswise of a truck body behind the cab. The rest of the truck body is free for loading other equipment. The net weight of the compressor on pneumatic tires is 2,750 lb. The length overall is 128½ in., width 64 in., and height

designed to eliminate slab shaped rocks in the crusher product.

This new style jaw plate has a wavy shape rather than a corrugated shape. The waves are spaced 6 in. from peak to peak, and the peak of one jaw fits into the valley of the opposite jaw. The effect of this shape of jaw plate on the crushing operation is to subject the slab-type rock to a true breaking strain, rather than to a squeezing pressure. The effect is the same as to lay a slab rock on a pair of supports and strike it between the support with a sledge hammer, breaking it in two. In

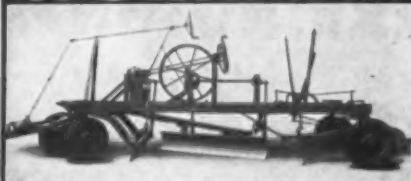


#### UTILITY SNOW PLOW

Especially designed to attach on car or light truck bumper. May be assembled or taken off car in 5 minutes. Very low in cost.

Also manufacture  
Sidewalk, Blade and "V" type plows.  
**JOHNSON SNOW PLOW, Inc.**  
1407 E. Erie Blvd., Syracuse, N. Y.

#### MASTER WORKMAN



For Better Roads, put a WORKMAN Machine on the job. 3 sizes:  
**THE GENERAL • THE SUPER  
THE MASTER**

**YORK MODERN CORPORATION**  
UNADILLA, NEW YORK

#### Reliance— CRUSHING SCREENING and WASHING UNITS

● UP TO 2000 TONS A DAY ●

Crushers	Bins	Drag-Lines
Elevators	Pulverizers	"GAYCO"
Screens	Feeders	Centrifugal
Sweepers	Spreaders	Air Separators
Wash Boxes	Kettles	
	Conveyors	

**UNIVERSAL ROAD MACHINERY CO.**  
Kingston, N. Y.

Canadian Representatives: F. H. Hopkins & Co., Ltd.  
340 Canada Cement Co., Montreal, Que., Can.

reality, there are a series of small gyratory crushers across the entire face of the jaws. Another benefit claimed to be derived from the wavy shape of the jaws is that the wear on the jaw surface is greatly reduced, and the effective working life of this new style jaw, therefore, is much greater than the old corrugated jaw.

### New Fire Guns

Two new sizes have been added to the Hauck Fire-Gun No. 250 by the Hauck Manufacturing Co., 124 Tenth St., Brooklyn, N. Y. These utility torches have

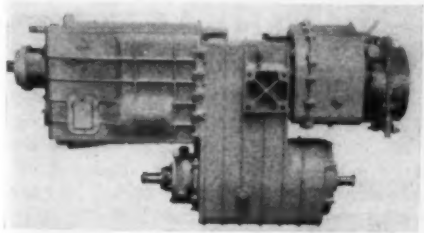


Hauck Fire-Guns

many uses, among which are: General repairs requiring heat, thawing in cold weather, weed burning in spring and maintenance work. Of the two new guns the No. 251 delivers a flame 4 in. by 36 in. at 2000° F. The No. 249 delivers a flame 2 in. by 20 in., also at 2000° F. The outfit consists of an all-welded steel fuel tank, fitted with a handle, quick acting heavy brass long stroke air pump; 60-lb. pressure gauge, 6-ft. length oil resisting hose, and a fully enclosed seamless steel coil Hauck burner with windshield, backplate and removable pan, fitted with bronze regulating valve and carrying handle. Further details will be found in Bulletin No. 1034.

### New Heavy Duty Transmission

A new transmission claimed to have many unusual features has been announced by The Four Wheel Drive Auto Co., FWD truck manufacturers, Clintonville, Wis. The new transmission is especially designed for heavy-duty 4-wheel drive service, and is arranged so that the regular five speeds provided in the gear box may be supplemented with a two-speed auxiliary that provides for ten speeds forward and two speeds in reverse. All of the gears in the new transmission are of the helical constant mesh type except first and reverse. Sliding clutches are used



Left Side View of New Heavy-Duty Transmission for FWD Trucks

throughout to insure easy shifting in all transmission speeds, including low and high range which may be shifted while the truck is in motion. A transfer case is bolted directly to the transmission in which a 12-in. wide silent chain is utilized to transfer the power from the level of the transmission main shaft to a point 177/16 in. below where the power is divided by a four pinion differential to the front and rear axles. A locking arrangement is provided on the differential so that differential action may be eliminated through the operation of a control in the driver's cab when a solid drive is desired to both axles.

A unique feature claimed for the new transmission is the ease with which it may be serviced. The entire mechanism, it is stated, may be disassembled in 1 hour and 30 minutes by two mechanics without removing the transmission and transfer case from the truck and without removing the cab or truck body.

The two-speed auxiliary transmission is arranged so that a selection of gear ratios in its low range may be provided that result in a gear reduction ranging from 1 3/4 to 1, to 2 1/2 to 1. With the proper selection of gear ratio in the auxiliary low range, the truck will operate from 15 to 18 miles per hour in high gear low range, thus avoiding the use of transmission gears in such work as snow removal except when a low ratio is required, in which case the operator would shift down from high gear to perhaps the fourth or third speed, eliminating the high torque in the transmission proper that would result if the auxiliary were not used and it became necessary to shift to low gear in the regular transmission.

### New 2-Cylinder Heavy Duty Engine

The Hercules Motors Corporation, Canton, O., has added a smaller 2-cylinder,



Model BXB Hercules Engine

heavy-duty, gasoline engine and power unit to its present line of 2, 4 and 6 cylinder gasoline and Diesel engines. The internal dimensions of the new model are as follows:

Model	Bore	Stroke	Displacement
BXB	2 7/8 in.	3 in.	39 cu. in.

The maximum torque of the BXB is 28 lb. feet at 1,200 R.P.M. For continuous

# OSGOOD



## POWER SHOVELS DRAGLINES CRANES, ETC.

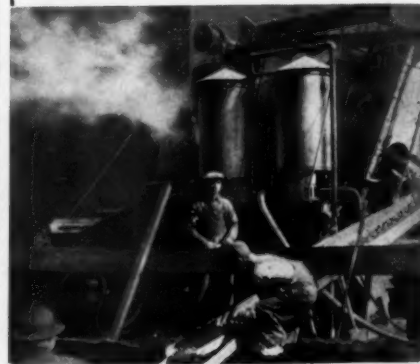
Write for New  
Descriptive Bulletins

3/8 to 2 Cu. Yds.

**THE OSGOOD CO.**  
MARION, OHIO  
DISTRIBUTORS IN ALL PRINCIPAL CITIES

# H A U C K

## Oil Burning WATER HEATERS



for heating large quantities of water in cold weather for concrete mixers and central mixing plants. Double Conical Heating Coil and Water Jacketed Shell heat mixing water from 40°F. to any temperature rise up to 180°F., efficiently, quickly and economically.

### ALSO

**CONCRETE HEATERS** heat aggregate in mixer, assuring uniform batch discharged at 60° to 90° F. even in zero weather. Holds heat 96 hours for ample setting time.

Other Hauck specialties include Oil Burning Salamanders, Super Heated Steam Thawing Outfits, etc.

**HAUCK MANUFACTURING COMPANY**  
119-129 10th St., Brooklyn, N. Y.



peak load service this engine can be operated up to 1,800 R.P.M., at which speed it develops 9.2 corrected horsepower. Although thermo-syphon cooling is standard practice on these 2-cylinder engines, water circulating pumps are available, and can be supplied if specified. Up-draft manifolds of either the center or rear-up outlet type can be furnished. The number 6 SAE bellhousing is furnished as standard equipment on the engines and the industrial power units, although the number 5 size can be furnished upon request. Full force lubrication to all main and connecting rod bearings is furnished and the lubricating pump is located in the oil sump and is driven by helical gears from the main camshaft. Oil pressure can be easily adjusted to suit the operating requirements. The crankcase is cast integral with the cylinder block, and carries the crankshaft support and two main bearings of ample proportion. These bearings are 2 in. in diameter, the front bearing is 1 1/4 in. long and the rear bearing 1 3/8 in. long, connecting rod bearings are 1 1/2 in. in diameter and 1 in. long, connecting rods being 5 1/4 in. in length from center to center. These engines have L-head cylinders and the valves have 30° seats. The crankshaft in the BXB is counter-balanced to compensate for the full amount of the rotating mass, plus 45 per cent of the reciprocating mass, making for exceptionally smooth two-cylinder operation.

#### New Motor Grader

A new heavy duty model motor grader has been added to the line of the W. A. Riddell Corporation, Bucyrus O. This machine is of the single-member frame, engine-over-transmission type, is fully power controlled, including hand and power steering, either of which is instantly avail-



New Riddell Motor Grader.

able at all times. It has all up-to-date features, such as extremely high lift, by which the blade can be set at an angle of 90 degrees for bank sloping, a full revolving circle permitting the machine to operate either forward or backward, as well as power controlled leaning front wheels. The machine will be available with either a 4-cylinder gasoline or full diesel engine. Arrangements have been made to show this machine, as well as other equipment, at the Chicago Road Show where it will be found in W. A. Riddell Corporation's Road Show Space D-2.

#### New Saw

A new saw has been added to the line of Mallsaws of the Mall Tool Co., 7765 South Chicago Ave., Chicago, Ill. This new Model 65 6 1/2 in. Mallsaw has a cutting capacity of 1 3/4 in. Cuts full 2 in.



New Model 65 6 1/2 In. Mallsaw

dressed lumber on straight cuts and 1 11/16 in. on 45 degree angle cuts. It has a powerful motor, adjustable base, chrome plated for long wear, sturdily constructed, lightweight castings to withstand severe usage and abuse, special alloy chrome nickle steel hardened gears, grip handle with trigger switch, extra large bearings, rip fence guide, and the Mall patented approved spring operated safety guard. Standard equipment includes one 6 1/2 in. combination crosscut and rip saw blade, 25 ft. 3 conductor rubber cord with two-prong plug, one tube lubricant and an all metal carrying case.

## WITH THE MANUFACTURERS

#### Don Smith Again with Sterling Machinery Corp.

Don W. Smith, who was with Sterling Machinery Corporation, Kansas City, Mo. during 1935 and 1936 and resigned in 1936 to become district sales manager for the Osgood Company, has again joined the sales department of Sterling Machinery Corporation. Sterling Machinery Corporation is just completing the most successful year in the history of their business and are on the verge of announcing a number of new units. With the addition of Mr. Smith to their sales organization and with the new units and increased facilities for modern, high quality, low cost, quantity production, they are confident the coming year will be even more successful than 1939.

#### Arthur C. Palm Appointed General Manager Davey Compressor

Appointment of Arthur C. Palm as general manager of the Davey Compressor Co., Kent, O., has been announced by Paul H. Davey, President. Mr. Palm for the past three years has been Davey sales promotion and advertising manager. Prior to his present affiliation he was production manager of "Campaigns, Inc.," national advertising service.

#### I. C. Moreau Joins Gar Wood

L. S. Wood, Vice President in charge of Engineering of Gar Wood Industries, Inc., Detroit, has announced the appointment of I. C. Moreau as his assistant. Mr. Moreau's duties will be confined to engineering work in the company's hoist and body division.

#### Edward J. Greene Elected Assistant Treasurer of Chain Belt

Chain Belt Company of Milwaukee, Wis., announces the election of Edward J. Greene as an assistant treasurer of the company. Mr. Greene was formerly assistant treasurer and purchasing agent of the Baldwin-Duckworth Chain Corp., of Springfield, Mass., which was recently merged with the Chain Belt Co. He is a member of the National Association of Cost Accountants and the Purchasing Agents' Association.

#### Link-Belt Promotes Ralph Hoffman

Ralph M. Hoffman, vice-president and sales manager of Link-Belt Company Pacific Division, San Francisco, for the last 8 years, has been appointed "Assistant to the President" of the parent organization, Link-Belt Co., with headquarters at the company's general office in Chicago. Mr. Hoffman, a graduate mechanical engineer, University of Minnesota, 1911, came to the Link-Belt organization in 1923 as manager of Link-Belt, Meese & Gottfried Co.'s Seattle branch. He served in this capacity until 1931, the name of the Pacific Coast subsidiary meanwhile becoming Link-Belt Company, Pacific Division and from 1931 to 1939 served as vice-president and sales manager of this subsidiary, with headquarters at San Francisco. Mr. Hoffman's previous experience consisted of: 1911-12, apprentice machinist, Smith Cannery Machines Co., Seattle; 1912, draftsman, Superior Portland Cement Co., Concrete, Wash.; 1913-15, branch manager, Meese & Gottfried Co., Vancouver, B. C.; 1916, sales engineer, Meese & Gottfried Co., Seattle; 1917-21, vice-president, Hesse-Martin Iron Works, Portland, Ore.; 1921-23, manager, Seattle branch, Meese & Gottfried Co.



R. M. Hoffman

#### New Home for Cummins Diesel Sales of Minnesota

Located on one of the main arteries between Minneapolis and St. Paul, 2350 University Ave., Cummins Diesel Sales and Service of Minnesota, have recently completed an ultra-modern air conditioned sales and service office. The \$15,000 building, 20 ft. high by 50 ft. wide by 90 ft. is not large but is ample to house all equipment necessary for Cummins Diesel service work. A lot in the rear of the building extends an additional 90 ft. which provides parking space for trucks and room for future expansion.

COME TO MEXICO CITY TO SEE THE

**HOTEL REFORMA**

THE HOTEL OF TOMORROW

The Reforma is truly the hotel of the future, providing deluxe and ultra-modern accommodations with every facility for comfort and convenience right in the midst of Mexico's glorious recreational opportunities. American and Mexican food. Low European Plan rates.

IN THE RESORT CAPITAL OF AMERICA

ALBERTO R. PAUL, Managing Director  
MANUEL CARRAL, Supervising Manager  
ANTONIO PEREZ, Exec. Asst. Manager

# Mexico City



**LITTLE GIANT** offers  
a Greatly Improved  
**Sand & Cinder  
SPREADER**  
with a Sensational  
New Feature

Gets material on in half the time, when minutes saved means lives saved. Avoids waste of material. Saves man power. Only 1 man needed on back. Priced well within reach of small towns as well as large cities and highway departments.

NEW "DIRECTIONAL" SPREAD CONTROL FEATURE

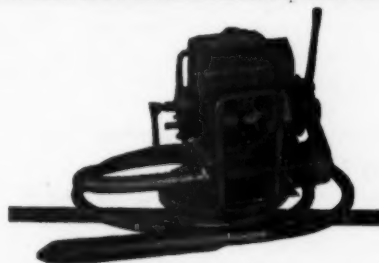
Little Giant hopper bottoms are circularly adjustable and feed opening rotates on complete 360 degree circle: MATERIAL SPREADS EXACTLY WHERE NEEDED, to left, right, rear or under wheels . . . on narrow city street, wide boulevard, or country highway.

Spinners 15" above road can't throw material on running boards. Covers 20' or wider. Disclutched when trailing or spreader can be hung by chains from dump body. Safety Feed Gate fits any dump body, saves material, increases speed, saves one man, provides utmost safety, inexpensive. Catalog No. 52-A rushed on request.

A few good territories open. Distributors, please write.

**PORTABLE ELEVATOR MFG. CO.**

BLOOMINGTON, ILLINOIS



Concrete

**VIBRATORS and GRINDERS**

Write for Circular on types, sizes and Prices

**White Mfg. Co.**

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**HOTEL  
ANTLERS**

*is like Living at Your Club*

Restful sleep in pleasant, ventilated rooms! Wonderful food, and cordial yet unobtrusive service! Facilities for comfort and convenience not found in the ordinary hotel! These and other splendid features make stopping at the Antlers like staying at your own club. The Meridian Room is Indianapolis' smartest, gayest cocktail lounge.

**INDIANAPOLIS**

MERIDIAN

AT ST. CLAIR

R.B. ZEIGLER, Mgr.

ONE OF THE  
ALBERT PICH  
HOTELS

OPPOSITE WORLD  
WAR MEMORIAL  
PARK

**200 ROOMS**

FROM \$2.25 WITH BATH

**DIG and HAUL at LOWEST COST**

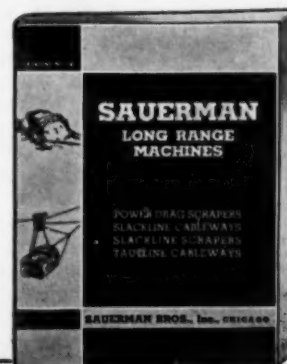
When you have a contract that requires moving dirt several hundred feet or more, isn't it logical to use a machine that will reach the entire distance and eliminate rehandling?

Sauerman Slacklines and Drag Scrapers will do just that—reach from 100 to 1,500 ft. and handle the digging, hauling and placing of the dirt in one operation. Costs are cut to the bone.

WRITE FOR CATALOG →

**SAUERMAN BROS., INC.**

488 S. Clinton Street, Chicago





### Gopher Equipment Co. to Handle Ransome Line

The Ransome Concrete Machinery Co., manufacturers of concrete mixers, pavers, and truck mixers with general offices and plant at Dunellen, N. J., have announced the appointment of Gopher Equipment and Supply Co., 1108 Second Ave. South, Minneapolis, Minn., to handle the complete Ransome line in all but a few counties in the states of Minnesota and Wisconsin.

### New Gar Wood Distributors

W. H. Hammond, Sales Manager of the Hoist and Body Division of Gar Wood Industries, Inc., Detroit, Mich., has announced the recent appointment of the following hoist and body distributors: Robert P. Stapp, 209 S. 18th St., Birmingham, Ala.; Lundberg Equipment Co., 257 N. Main St., Logan, Utah; Cate Equipment Co., 722 S. State St., Salt Lake City Utah; Wilson Equipment & Supply Co., 902 West 22nd St., Cheyenne, Wyo. M. P. Arnold has been made Buffalo Branch Representative at Rochester, N. Y.

### Bucyrus-Erie Appoints J. F. Tait Manager of Pittsburgh Sales District

Bucyrus-Erie Co. has announced the appointment of J. F. Tait as district manager of their Pittsburgh Sales District with offices at 1502 Clark Bldg., Pittsburgh, Pa. Mr. Tait has been associated with Bucyrus-Erie for 22 years and prior to this appointment was in charge of the Philadelphia office, serving there as an assistant manager for the Eastern Sales District. At Pittsburgh, he succeeds P. B. Heisey, who resigned to enter business for himself.

### Gardner-Denver Appoints Syracuse Supply Co. as Distributor

The Gardner-Denver Co., Quincy, Ill., has appointed the Syracuse Supply Co. as a new distributor, covering the western part of New York State. Complete sales and service facilities on Gardner-Denver parts are available at the Syracuse, Rochester, and Buffalo branch offices of the Syracuse Supply Co.

### Vern Wheeler Equipment Co. Establishes New Office at Columbus, O.

The Vern Wheeler Equipment Co., organized early this year by Vern Wheeler, announces the establishment of a new office and warehouse at 480 W. Spring St., Columbus, O. The property, leased from the Cleveland Trinidad Paving Co., is in the process of being remodeled and improved in order to make it more adaptable to the new company's use. Among the nationally known equipment manufacturers being represented are: Northwest Engineering Co., shovels, cranes and draglines; Jaeger Machine Co., concrete mixers, pumps, etc.; Macleod Co., tar and asphalt heating kettles; Le Roi Co., air compressors, gasoline and diesel engines; Murphy Diesel Co., diesel motors; Independent Pneumatic Air Tool Co., pneumatic and electric tools; Wire

Rope Corp. of America, wire rope; and other miscellaneous construction and machinery tools.

### Brown Now Washington, D. C., Representative of California Redwood Association

E. A. Brown, formerly in the structural department of the California Redwood Association, has been appointed Washington representative. Brown, an authority on structural utilization of wood, has been instrumental in the design and extensive use of redwood for bridges and other construction in the western states. He is a graduate of the civil engineering department of the University of Nevada. His new duties will be concerned with general redwood promotion, and he will be located permanently in Washington, D. C.

## NEW LITERATURE

**Compressors, Drills, Etc.**—A 56-page catalog has been published by Chicago Pneumatic Tool Co., 6 East 44th St., New York, giving details of CP equipment and tools for contractors. Essential data including specifications are given of compressors, rock drills, wagon drills, demolition tools, diamond drills, pneumatic tools, concrete vibrators and electric tools.

**New Publications of Asphalt Institute**—Three separate pamphlets, reprinted from the Proceedings of the 12th National Asphalt Conference, have been issued by The Asphalt Institute. They comprise 23 papers, covering "20 years of progress" grouped as follows:

Research Series Number 5—Materials (60 pages).

A review, analysis and forecast, including "Slow Curing Asphaltic Products," "Cut-Back Asphalts," "Emulsified Asphalts," "Asphalt Cements," "Penetration Asphalt Tests," "Mineral Aggregates." Construction Series Number 49—Design and Construction (56 pages).

Analyses of asphaltic types, including "Relation of Base to Wearing Course," "Surface Treatment," "Road-Mix," "Penetration Macadam," "Plant-Mix," "Airports."

Construction Series Number 50—Equipment (72 pages).

Development for bituminous construction, including "Equipment for Earth Moving," "Distributors," "Rollers," "Graders," "Mixing Plants," "Spreaders," "Maintenance Tools."

Single copies of these reprint pamphlets can be obtained without charge upon request to The Asphalt Institute, 801 Second Ave., New York, N. Y.

**Asphalt Plants**—A circular dealing with its products has been issued by The McCarter Iron Works, Inc., Morristown, Pa., an organization that has been identified with the asphalt paving industry for many years. Illustrations are given of several steamless asphalt paving plants. Included also is information on the company's "telescopic drier" (which it is claimed will successfully dry Potomac River sand), its A. C. buckets and its pug mill mix-

ers. The bucket is of the non-tilting, non-leaking type, steam or electrically heated.

**Snow Plows and Ice Control Equipment**—The 1940 models of Ross snow plows are covered in a catalog issued recently by The Burch Corporation, Crestline, O. Special features of the plows are illustrated and described and specifications are given for the various models. Included also are descriptions and illustrations of frame and body attachments for wings as well as specifications for standard wings. A section is devoted to sand and chip spreaders.

**High Early Strength Cement**—A 16 page booklet on Penn-Dixie high early strength cement has been issued by the Pennsylvania-Dixie Cement Corporation, 60 East 42nd St., New York, N. Y. The booklet explains what high early strength cement is and lists advantages and benefits to contractors, architects, and property owners. It includes interesting and helpful data pertaining to cold weather concreting and the production of watertight concrete. Two pages of tables briefly outline construction methods for mixing and curing quick-use concrete under various weather conditions.

**Power Shovel**—Catalog 55-B describing its Model 55 equipped with 1-yd. bucket and with crane rating of 15 tons, has been issued by Bay City Shovels, Inc., Bay City, Mich. Profusely illustrated it gives details of construction and includes photos of unit-cast alloy steel bases for lower carbody and revolving table; electric power dipper trip; heavy duty chain crowd; helical gears with transmission in oil, etc. Complete specifications and working ranges for shovel, crane, dragline and trench hoe service are also reviewed in detail.

**Snow Removal and Ice Control Equipment**—Champion snow removal and ice and sleet control equipment are illustrated and described in a recent catalog of the Good Roads Machinery Corp., Kenneth Square, Pa. Included are blade plows, V-plows, 1-way plows, tractor plows and wings. Data and dimensions for each are given. A section is devoted to ice and sleet control equipment, including 8 types of spreaders.

**Load Luger**—The Brooks Equipment & Manufacturing Co., Knoxville, Tenn., has issued Bulletin 209 illustrating and describing its new Model C. H. load lugger—a multi-body system for loading, hauling and dumping. The load lugger can be quickly mounted on any standard chassis and it is stated a 1½ ton truck will handle a 2-yd. bucket fully loaded.

**Truck Shovel Crane**—A catalog illustrating and describing its Bay City Model 18 truck-shovel crane of ¾ yd. capacity with 16½ ton crane rating has been issued by Bay City Shovels, Inc., Bay City, Mich. The catalog reviews important details of machinery assembly featuring unit-cast alloy steel revolving table, tandem drums, helical gears, chain crowd and mounting of cast roller path on built-up structural truck frame. Complete specifications and working ranges for shovel and crane operation are given. Write for Catalog 18-A.

*Ready in January*

# ROAD AND STREET COST DATA

A Compilation of Records of Methods and Costs of Construction Operations on Rural and Urban Highways.

By **HALBERT P. GILLETTE**

Author, Handbook of Cost Data. Editor, Roads & Streets

and **JOHN C. BLACK**

Associate Editor, Roads & Streets

Modern, systematic and fully indexed, this book is designed for the practical use of Engineers, Contractors, and Highway Officials.

## SUBJECTS COVERED INCLUDE:

Engineering	Hauling and Handling	Retaining Walls, Crib-
Other Overheads	Materials	bing, etc.
Right of Way	Untreated Surfaces	Bridges and Culverts
Equipment	Stabilization	Tunnels and Subways
Labor	Bituminous Surfaces of	Fences and Guard Rails
Clearing and Grubbing	all Types	Signs, Signals and
Grading	Concrete Pavements	Traffic Stripes
Landscaping	Brick Pavements	Lighting
	Sidewalks—Curbs—	and Other Subjects
	Gutters	

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**PRICE \$6.00**  
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330 South Wells St., Chicago, Ill.

Gentlemen:

Please send me a copy of "Road and Street Cost Data" for examination. Within 10 days I agree to remit \$6.00, plus postage, or return the book postpaid.

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Position or Business.....

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## NEW BOOKS

### GEOLOGY FOR CIVIL ENGINEERS

As Related to Highway Engineering

By **Delmar C. Runner**

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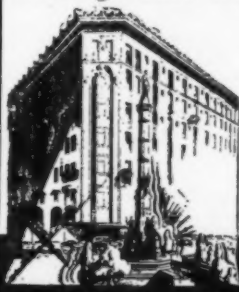
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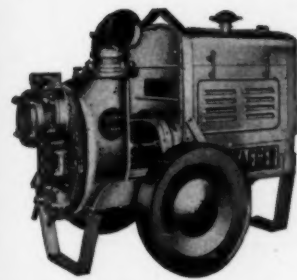
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